KOSTRZEWA®
Ogrzewanie i wentylacja

OŚWIADCZENIE

Firma Przedsiębiorstwo Produkcyjno Handlowe Kostrzewa sp.k. oświadcza, iż pompy ciepła

1. HPR 400 Deluxe
2. HPR 500 Deluxe

należą do jednego podtypu w danym typoszeregu i spełniają łącznie następujące warunki:

• identyczna konstrukcja obiegu chłodniczego, ten sam czynnik chłodniczy/roboczy;

• ten sam producent, typ i liczba sprężarek;

• ten sam typ elementu rozprężnego;

• ten sam typ skraplacza;

• ten sam typ parownika;

• ten sam typ procesu odszraniania;

• ten sam sterownik i zasada sterowania wydajnością;

• ten sam producent, typ i liczba wentylatorów parownika (w przypadku powietrznych pomp ciepła) i zasada sterowania wydajnością (stała, zmienna lub stopniowana regulacja prędkości obrotowej);

• urządzenia z i bez zaworu czterodrogowego nie mogą być zaliczone do tego samego typoszeregu.

Giżycko, dnia 25.07.2024

Paweł Kostrzewa
Współwłaściciel

PPH KOSTRZEWA sp.k.

www.kostrzewa.com.pl

11-500 Giżycko, ul. Przemysłowa 11A
+48 87 429 56 00
biuro@kostrzewa.com.pl
NIP: 845-16-35-621

Tłumaczenie z oryginału dokumentu w języku angielskim

/logo/

SZU

Strojírenský zkušební ústav, s.p., Brno, Česká republika

Instytut Badawczy Przemysłu Maszynowego, przedsiębiorstwo państwowe, Republika Czeska

ŚWIADECTWO BADAŃ

Numer **O-B-00432-24**

Klient	PPH Kostrzewa sp.k. Przemysłowa 11A 11-500 Giżycko POLSKA
Wyrób	Pompa ciepła powietrze/woda - monoblok
Oznaczenie typu / Znak towarowy	**HPR 500 DELUXE**
Metody badań	ČSN EN 14511-2:2023, ČSN EN 14511-3:2023, ČSN EN 14825:2023;
Podstawa wydania świadectwa	Raporty z badań: 39-17488/T z dnia 21.03.2024 r. Dokumentacja techniczna PPH Kostrzewa sp.k.
Referencyjny sezon grzewczy	**„A" = klimat umiarkowany** (Temperatura obliczeniowa odniesienia $T_{designh}$ = -10 °C)

Wyniki:

NISKA TEMPERATURA
(Referencyjna temperatura wody 35 °C)

ŚREDNIA TEMPERATURA
(Referencyjna temperatura wody 55 °C)

10,39	**$P_{designh}$ [kW]** ... Ogrzewanie przy pełnym obciążeniu				**9,99**
4,03	**SCOP [–]** ... Wskaźnik sezonowej efektywności				**3,39**
Temperatura zewnętrzna **T_j [°C]**	Deklarowana wydajność grzewcza **P_{dh} [kW]**	Wskaźnik efektywności przy deklarowanej wydajności **COP_d [–]**	Temperatura zewnętrzna **T_j [°C]**	Deklarowana wydajność grzewcza **P_{dh} [kW]**	Wskaźnik efektywności przy deklarowanej wydajności **COP_d [–]**
T_j = -7	9,193	3,289	T_j = -7	8,839	2,566
T_j = +2	10,077	3,756	T_j = +2	10,130	3,232
T_j = +7	13,365	5,029	T_j = +7	13,211	4,173
T_j = +12	15,372	5,722	T_j = +12	15,119	5,056
T_j = TOL = -10	8,437	3,129	T_j = TOL = -10	8,252	2,336
T_j = $T_{bivalent}$ = -7	9,193	3,289	T_j = $T_{bivalent}$ = -7	8,839	2,566

/okrągła pieczęć z logo SZU w środku i napisem w otoku: STROJÍRENSKÝ ZKUŠEBNÍ ÚSTAV, s.p., CZ 1/

/hologram z logo SZU/

NISKA TEMPERATURA (Referencyjna temperatura wody 35 °C)	*/logo SZU/*			**ŚREDNIA TEMPERATURA** (Referencyjna temperatura wody 55 °C)
	Pobór mocy w trybach innych niż aktywny:			
9,5	Tryb wyłączenia	P_{OFF}	[W]	9,5
12,8	Tryb wyłączonego termostatu	P_{TO}	[W]	12,8
12,7	Tryb czuwania	P_{SB}	[W]	12,7
0,0	Tryb włączonej grzałki karteru	P_{CK}	[W]	0,0
	Roczne zużycie energii elektrycznej na ogrzewanie według:			
5323	ČSN EN 14825:2023	Q_{HE}	[kWh]	**6089**
	Sezonowa efektywność energetyczna ogrzewania pomieszczeń			
158,3	ČSN EN 14825:2023	η_s	[%]	**132,6**
	Natężenie przepływu cieczy w zewnętrznym wymienniku ciepła:			
–	Ciecz źródłowa	Min/Max	[m³/h]	–
	Natężenie przepływu cieczy w wewnętrznym wymienniku ciepła:			
1,4608 / 2,6539	Woda grzewcza	Min/Max	[m³/h]	**0,8999 / 1,6387**

Specyfikacja warunków:

Kontrola prędkości kompresora	**Stała**	Objętościowe natężenie przepływu wody grzewczej (wewnętrzny wymiennik ciepła)	**Zmienne**
Temperatura wylotowa wody (wewnętrzny wymiennik ciepła)	**Zmienna**	Objętościowe natężenie przepływu cieczy źródłowej (zewnętrzny wymiennik ciepła)	–
Funkcja	**Odwracalna**		

Instytut Badawczy Przemysłu Maszynowego, przedsiębiorstwo państwowe, niniejszym świadectwem badania potwierdza, że przeprowadzono dla przedmiotowego wyrobu badania z wynikami podanymi powyżej. Instytut Badawczy Przemysłu Maszynowego, przedsiębiorstwo państwowe, jest akredytowanym laboratorium badawczym nr 1045.1.

Brno, 21.03.2024 r.

/nieczytelny podpis odręczny/

Inż. Mario Jankola

Kierownik ds. urządzeń grzewczych i wyrobów budowlanych

– KONIEC ŚWIADECTWA BADAŃ –

/okrągła pieczęć z logo SZU w środku i napisem w otoku: STROJÍRENSKÝ ZKUŠEBNÍ ÚSTAV, s.p., CZ 1/

Instytut Badawczy Przemysłu Maszynowego, przedsiębiorstwo państwowe, Hudcova 424/56b, 621 00 Brno, Republika Czeska

www.szutest.cz

Ja, Urszula Dorota Kallas, tłumacz przysięgły języka angielskiego i francuskiego, wpisana na listę tłumaczy przysięgłych Ministra Sprawiedliwości pod numerem TP/4520/05, stwierdzam, że niniejsze tłumaczenie w pełni odpowiada przedstawionemu mi oryginałowi dokumentu.

Warszawa, 27.03.2024 r. Rep. Nr 225/2024

URSZULA DOROTA KALLAS TŁUMACZ PRZYSIĘGŁY JĘZYKA ANGIELSKIEGO TP/4520/05

Strojírenský zkušební ústav, s.p., Brno, Česká republika
Engineering Test Institute, Public Enterprise, Brno, Czech Republic

TEST CERTIFICATE

Number **O-B-00432-24**

Customer	PPH Kostrzewa sp.k. Przemysłowa 11A 11-500 Giżycko POLAND
Product	Air/water heat pump – monobloc
Type designation / Trademark	**HPR 500 DELUXE**
Test methods	ČSN EN 14511-2:2023, ČSN EN 14511-3:2023, ČSN EN 14825:2023;
Basis of certificate	Test reports: 39-17488/T *of* 2024-03-21 Technical documents of PPH Kostrzewa sp.k.
Reference heating season	**„A“ = average** (Reference design temperature $T_{designh}$ = -10 °C)

Results:

LOW TEMPERATURE (Reference water temperature 35 °C)		MEDIUM TEMPERATURE (Reference water temperature 55 °C)
10.39	**$P_{designh}$ [kW]** … Full load heating	**9.99**
4.03	**SCOP [–]** … Seasonal coefficient of performance	**3.39**

Outdoor temperature T_j [°C]	Heating declared capacity P_{dh} [kW]	Coefficient of performance at the declared capacity COP_d [–]	Outdoor temperature T_j [°C]	Heating declared capacity P_{dh} [kW]	Coefficient of performance at the declared capacity COP_d [–]
T_j = -7	9.193	3.289	T_j = -7	8.839	2.566
T_j = +2	10.077	3.756	T_j = +2	10.130	3.232
T_j = +7	13.365	5.029	T_j = +7	13.211	4.173
T_j = +12	15.372	5.722	T_j = +12	15.119	5.056
T_j = TOL = -10	8.437	3.129	T_j = TOL = -10	8.252	2.336
T_j = $T_{bivalent}$ = -7	9.193	3.289	T_j = $T_{bivalent}$ = -7	8.839	2.566

STROJÍRENSKÝ ZKUŠEBNÍ ÚSTAV, s.p. CZ 1

Strojírenský zkušební ústav, s.p., Hudcova 424/56b, 621 00 Brno, Česká republika
Engineering Test Institute, public enterprise, Hudcova 424/56b, 621 00 Brno, Czech Republic
www.szutest.cz

LOW TEMPERATURE
(Reference water temperature 35 °C)

MEDIUM TEMPERATURE
(Reference water temperature 55 °C)

Power consumption in modes other than „active mode“:

9.5	Off mode	P_{OFF}	[W]	9.5
12.8	Thermostat off mode	P_{TO}	[W]	12.8
12.7	Standby mode	P_{SB}	[W]	12.7
0.0	Crankcase heater mode	P_{CK}	[W]	0.0
	Annual electricity consumption for heating according to:			
5323	ČSN EN 14825:2023	Q_{HE}	[kWh]	**6089**
	Seasonal Space heating energy efficiency			
158.3	ČSN EN 14825:2023	η_s	[%]	**132.6**
	Liquid flow rate in outdoor heating exchanger:			
–	Source liquid	Min/Max	[m^3/h]	**–**
	Liquid flow rate in indoor heating exchanger:			
1.4608 / 2.6539	Heating water	Min/Max	[m^3/h]	**0.8999 / 1.6387**

Specification of conditions:

Compressor speed control	**Fixed**	Heating water volume flow rate (indoor heat exchanger)	**Variable**
Outlet water temperature (indoor heat exchanger)	**Variable**	Source liquid volume flow rate (outdoor heat exchanger)	**–**
Function	**Reversible**		

Engineering Test Institute, Public Enterprise, confirms by this Test Certificate that the testing of the product in question was performed with the results as stated above. Engineering Test Institute, Public Enterprise, is an accredited Testing Laboratory 1045.1.

Brno, 2024-03-21

Ing. Mario Jankola
Heating Equipment and Construction Products Manager

– END OF TEST CERTIFICATE –

STROJÍRENSKÝ ZKUŠEBNÍ ÚSTAV, s.p. CZ 1

Strojírenský zkušební ústav, s.p., Hudcova 424/56b, 621 00 Brno, Česká republika
Engineering Test Institute, public enterprise, Hudcova 424/56b, 621 00 Brno, Czech Republic
www.szutest.cz

L 1045.1

TEST REPORT
39-17727/1/H_shortened

Product: Outdoor Air/Water Heat pump - monobloc

Type designation: **HPR 500 DELUXE**

Customer:
PPH Kostrzewa sp.k.
Przemysłowa 11A
11-500 Giżycko
POLAND

Manufacturer:
PPH Kostrzewa sp.k.
Przemysłowa 11A
11-500 Giżycko
POLAND

Report issue date: 2024-07-02

Distribution list:
1 copy to the Customer
1 copy to the Engineering Test Institute

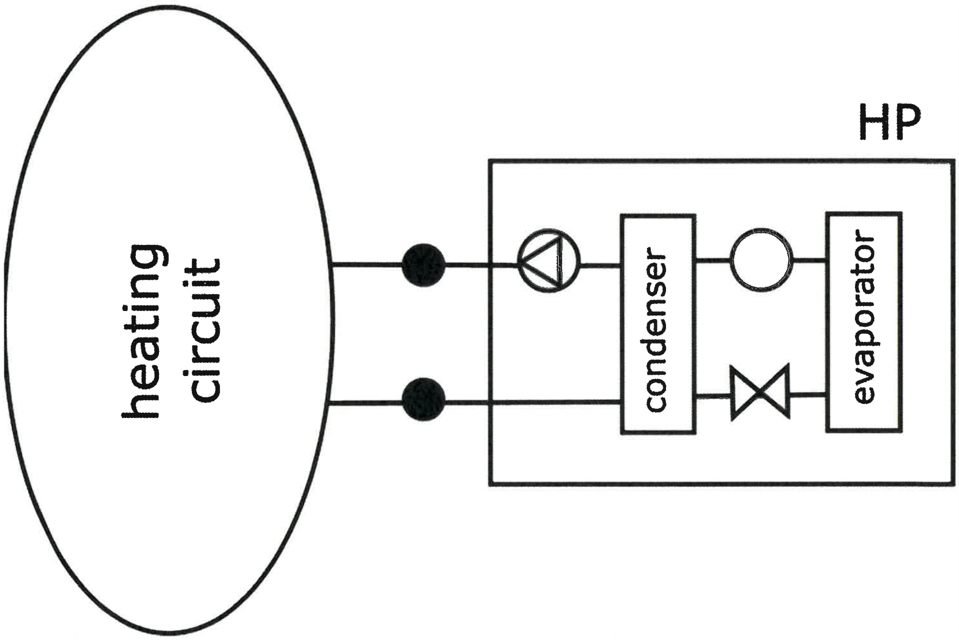
I. Description of product tested

The Heat pump **HPR 500 DELUXE** supplied by the company **PPH Kostrzewa sp.k.** is structurally adapted to operate in air/water system. Device is designed as monobloc placed outdoor. Refrigerant R290 is used with charge 0.95 kg. Power supply is a three-phase. Heat pump is able to work in heating and cooling mode. Heat pump is working with variable flow rate.

Main components of the outdoor unit **HPR 500 DELUXE**:

- Serial number 500143
- Refer to report 39-17727/1/H of 2024-06-28

Scheme:



II. Sample tested

SZU reg. no.	Product name	Date of submission
1212.24.39878.001	**HPR 500 DELUXE**	2024-04-17

The visual inspection, tests and verification were carried out by Ing. Ondrej Bilkovič at the test station of SZU. The tests were performed using measuring and testing equipment with valid calibration.

III. Measuring and test equipment:

No.	Description	Inventory number
1.	Electrical energy meter	E2.1
2.	Digital watt meter	1.2.2 ENERGIE ANALYZATOR_2
3.	Flow meter Krohne Optiflux	8.1.2 TECH_K2_V_DN15
4.	Barometer	2.3 MAR18_1_PB
5.	Differential pressure gauge	3.2 MAR18_2_dP
6.	Thermometers	3.4 MAR18_T
7.	Thermo-hydro meter 608-H1	117043
8.	Tape measure	ME 475
9.	Multi-analyser SINUS SoundBook MK2	000-000-000-875/1
10.	Microphone pair G.R.A.S. 40 AK, wind deflector	000-000-000-875/2
11.	Calibrator G.R.A.S. 42AG	000-000-000-875/3

IV. Methods, results of tests and verifications

No.	Test objective	Requirement	Method of test	Documentation	Test evaluation/ verification *
1.	Calculation of sound power level	Art. 9	**ČSN ISO 9614-2:1997**	Page No. 5-12	+
2.	Acoustic measurements – Sound power level	Art. 8	**ČSN EN 12102-1:2023**	Page No. 4-12	+

***) Evaluation / statement of conformity:**

+...... Requirement fulfilled
-....... Requirement not fulfilled
0 ......Not applicable
x ......Not evaluated

Note:
The stated extended measurement uncertainties are calculated as a factor of the measurement uncertainty and the extension coefficient k=2, corresponding to the coverage certainty of 95% as regards standard classification.

If a statement of conformity is provided, the decision rule pursuant to ILAC-G8:09/2019, Art. 4.2.1 – binary statement for the simple acceptance rule shall apply.

Test objective:	Heating and cooling equipment
Exact name of the test procedure:	**2.136*** - Measurement of noise characteristics
Test method:	**ČSN EN 12102-1:2023; ČSN ISO 9614-2:1997**
Sample tested:	Air/Water Heat pump **HPR 500 DELUXE**
Measuring equipment used:	see Chapter III
Place of test:	Engineering Test Institute, Hudcova 424/56b, 621 00 Brno, CZ

Measurement uncertainty:

Measured quantity	**Unit**	**Uncertainty of measurement**	**Evaluation**
Liquid			
- temperature difference (dT)	[K]	± 0.15 K	fulfilled
- temperature inlet/outlet	[°C]	± 0.15 K	fulfilled
- volume flow	[m^3/s]	± 1 %	fulfilled
- static pressure difference	[kPa]	± 1 kPa (Δp ≤ 20 kPa) or ± 5 % (Δp > 20 kPa)	fulfilled
Air			
- dry bulb temperature	[°C]	± 0.2 K	fulfilled
- wet bulb temperature	[°C]	± 0.4 K	fulfilled
- volume flow	[m^3/s]	± 5 %	not applied
- static pressure difference	[Pa]	± 5 Pa (Δp ≤ 100 Pa) or ± 5 % (Δp > 100 Pa)	not applied
Refrigerant			
- pressure at compressor outlet	[kPa]	± 1 %	not applied
- temperature	[°C]	± 0.5 K	not applied
Concentration (in volume)			
- heat transfer medium	[%]	± 2	not applied
Electrical quantities			
- electric power	[W]	± 1 %	fulfilled
- voltage	[V]	± 0.5 %	fulfilled
- current	[A]	± 0.5 %	fulfilled
- electric energy	[kWh]	± 1 %	not applied
Compressor rotational speed	[min^{-1}]	± 0.5 %	not applied
The heating or cooling capacities measured on the liquid side shall be determined within a maximum uncertainty of 5 % independent of the individual uncertainties of measurement including the uncertainties on the properties of fluids.			fulfilled

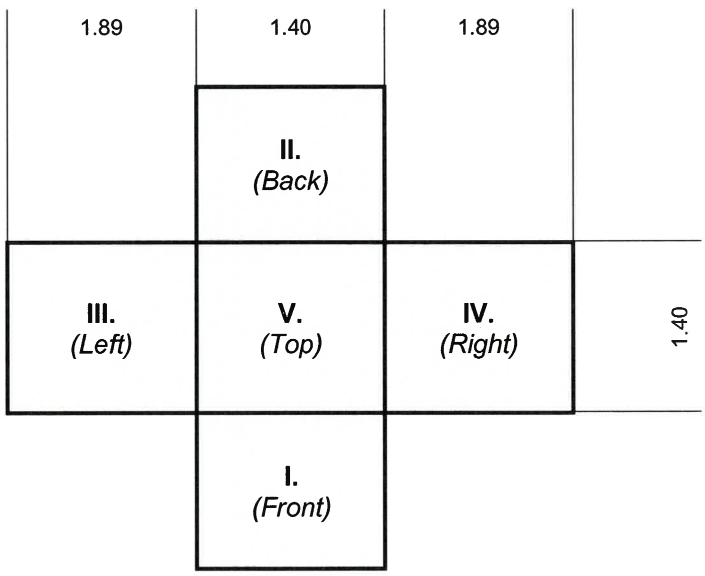
a) Measurement surface

Tested samples were surrounded by a cuboid-shape measuring surface set at the distance *d* [m].

Test Sample: Air/Water Heat pump **HPR 500 DELUXE**			
Distance from the test sample	*d*	[m]	0.20
Height of measurement surface	*h*	[m]	1.89
Width of measurement surface	*w*	[m]	1.40
Depth of measurement surface	*l*	[m]	1.40
Total measurement surface area	*S*	[m^2]	12.54
Minimal measuring time per surface	t_M	[s]	90.00

Sketch of measurement surface (not to scale):

Air/Water Heat pump **HPR 500 DELUXE**
– Outdoor unit –



b) Acoustic environment

The device under test was placed inside a climate chamber (dimensions shown below). The chamber was acoustically treated to be compliant with ČSN EN ISO 3745:2012 requirements for hemi-anechoic chambers. The background noise was stable with the main noise source being the air conditioning of the climate chamber which was set to lower power or momentarily turned off for sufficient signal to noise ratio. The device under test was placed in a position offset from the middle of the chamber, at a sufficient distance from the surrounding walls, and was rotated by about 5÷10 °. Care was taken to ensure low air flow at the measurement surface by varying the measurement distance and positions. The DUT was taken off from the delivery palette.

Climate-acoustic chamber *(corresponds to free field over a reflecting plane)*			
Width of testing room	l_1	[m]	3.75
Length of testing room	l_2	[m]	4.50
Height of testing room	l_3	[m]	4.25

c) Measured and calculated data – General overview:

Test sample			Air/Water Heat pump **HPR 500 DELUXE**
The measured values are in accordance with ČSN EN 12102-1:2023			YES
The measured values are in accordance with ČSN EN ISO 9614-2:1997			YES
Operation mode			Heating
Specification of the assessment condition			A7/W55*
Type of HP capacity regulation			Fixed
Compressor speed settings			on/off (50 Hz)
Fan speed settings			AUTO
Date of testing (YYYY-MM-DD)			2024-05-15
Reference air temperature	t_{amb}	[°C]	7.0
Relative humidity of air	RH	[%]	87.1
Ambient pressure	p_{amb}	[hPa]	984.5
Overall sound power level (linear)	L_W	[dB]	66.1 ± 1.5
Overall A-weighted sound power level	L_{WA}	**[dB(A)]**	**58.1 ± 1.5**
Accuracy class			**Engineering** **(grade 2)**

*) *Comment to abbreviated marking: i.e. A7/W55*
A (water), 7 (input source liquid temperature in °C) / W (water), 55 (outlet heating water temperature in °C)

1A) **Measurement results** – octave bands

Air/Water Heat pump **HPR 500 DELUXE** Outdoor unit at A7/W55; on/off	**Engineering (Grade 2)**

f_m [Hz]	Criterion 1 L_d	Criterion 1 F_{pl}	Criterion 1 $L_d > F_{pl}$	Criterion 2 $F_{+/-}$	Criterion 2 $F_{+/-} \leq 3$	Criterion 3 $L_{W(1)}$-$L_{W(2)} \leq s$	All criteria passed?	L_W [dB]	L_{WA} [dB(A)]	U [dB]	Evaluation
125	27.7	4.3	YES	0.0	YES	YES	YES	65.0	51.2	± 3.0	c
250	28.0	1.8	YES	0.0	YES	YES	YES	54.4	45.7	± 2.0	passed
500	28.3	3.0	YES	0.0	YES	YES	YES	55.6	52.6	± 1.5	passed
1000	**20.7**	**2.9**	**YES**	**0.0**	**YES**	**YES**	**YES**	**53.3**	**53.2**	**± 1.5**	**passed**
2000	21.1	2.5	YES	0.0	YES	YES	YES	46.8	48.0	± 1.5	c
4000	20.3	2.6	YES	0.0	YES	YES	YES	41.4	42.3	± 1.5	c
8000**)	19.9	5.0	YES	0.0	YES	YES	YES	37.0	36.9	± 2.5	c
Total								**66.1**	**58.1**	**± 1.5**	

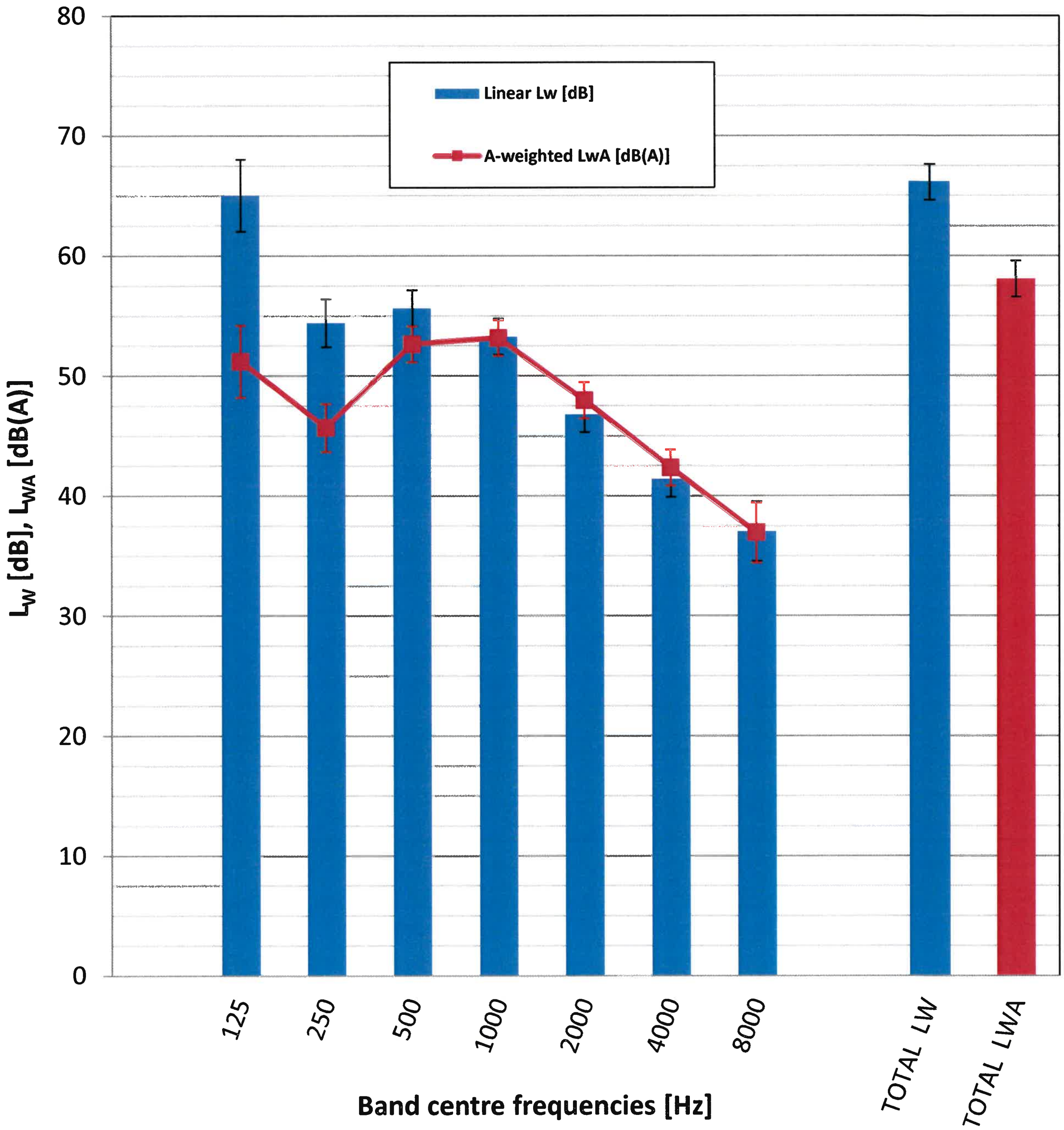
*) *Due to the sound intensity method limitations, the frequency of 6300 Hz was measured only.*

Legend:

passed	*Frequency bands with this description are significant for the calculation of A-weighted total sound power level L_{WA}. Required accuracy class is fulfilled in this band.*
not passed	*Frequency bands with this description are significant for the calculation of A-weighted total sound power level L_{WA}. Required accuracy class is not fulfilled in this band.*
c	*Frequency bands with this description are not significant for the calculation of A-weighted total sound power level L_{WA}. These bands are evaluated in the calculation of L_{WA}.*
nc	*Frequency bands with this description are not significant for the calculation of A-weighted total sound power level L_{WA}. These bands are not evaluated in the calculation of L_{WA}.*

Spectrum of Sound power level L_W – octave bands

Air/Water Heat pump **HPR 500 DELUXE** Outdoor unit at A7/W55; on/off	**Engineering** **(Grade 2)**



1B) **Measurement results** – one-third octave bands

Air/Water Heat pump **HPR 500 DELUXE** Outdoor unit at A7/W55; on/off	**Engineering** **(Grade 2)**

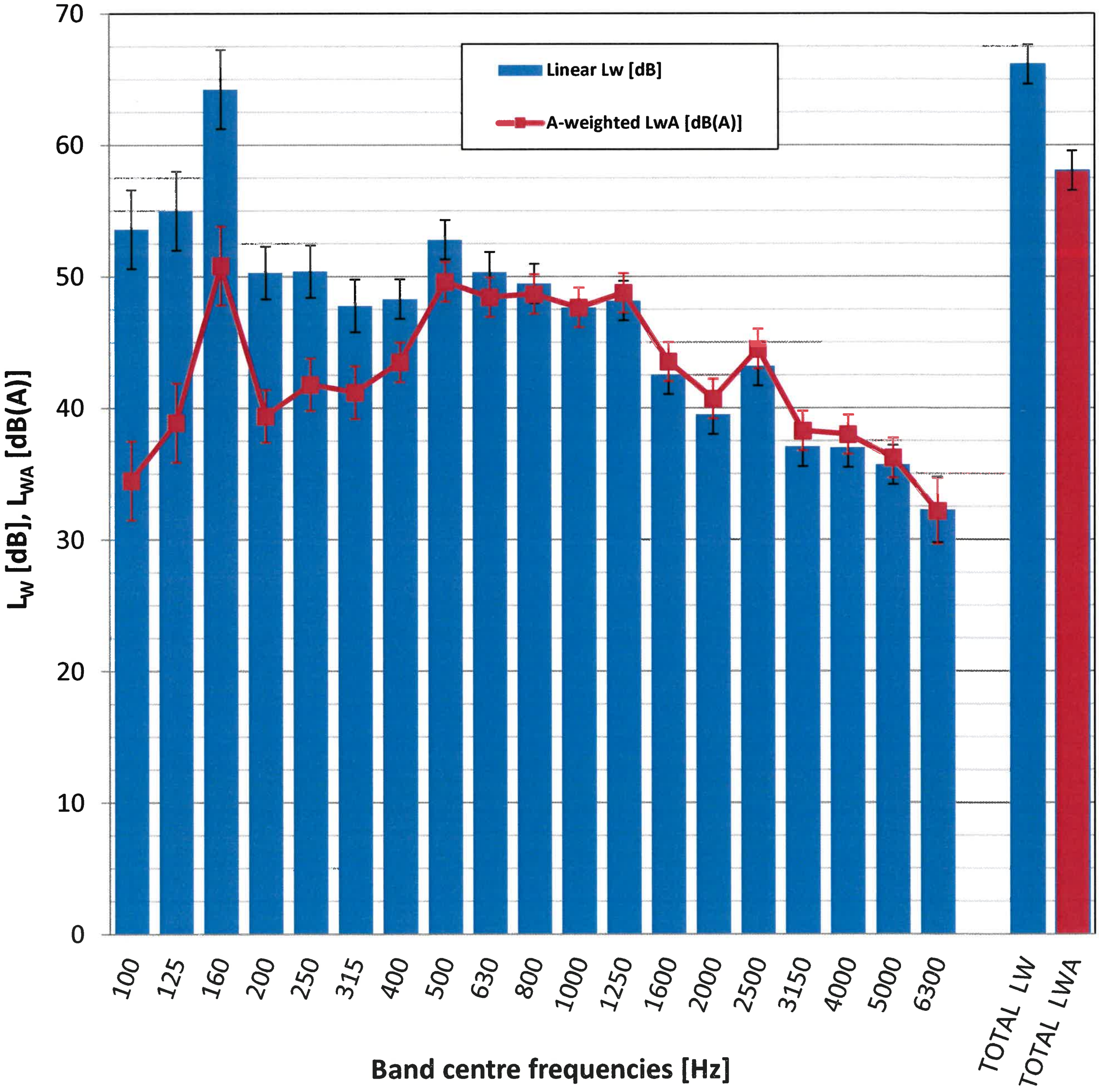
f_m [Hz]	**Criterion 1** L_d	F_{pl}	$L_d > F_{pl}$	**Criterion 2** $F_{+/-}$	$F_{+/-} \leq 3$	**Criterion 3** $L_{W(1)}-L_{W(2)} \leq s$	**All criteria passed?**	**L_W** [dB]	**L_{WA}** [dB(A)]	**U** [dB]	**Evaluation**
100	27.8	4.5	YES	0.0	YES	YES	YES	53.6	34.5	± 3.0	c
125	27.7	4.3	YES	0.0	YES	YES	YES	55.0	38.9	± 3.0	c
160	**27.8**	**2.6**	**YES**	**0.0**	**YES**	**YES**	**YES**	**64.2**	**50.8**	**± 3.0**	**passed**
200	27.9	3.0	YES	0.0	YES	YES	YES	50.3	39.4	± 2.0	c
250	28.0	1.8	YES	0.0	YES	YES	YES	50.4	41.8	± 2.0	passed
315	28.4	2.7	YES	0.0	YES	YES	YES	47.8	41.2	± 2.0	passed
400	28.5	3.5	YES	0.0	YES	YES	YES	48.3	43.5	± 1.5	passed
500	**28.3**	**3.0**	**YES**	**0.0**	**YES**	**YES**	**YES**	**52.8**	**49.6**	**± 1.5**	**passed**
630	28.1	2.7	YES	0.0	YES	YES	YES	50.3	48.4	± 1.5	passed
800	21.8	3.3	YES	0.1	YES	YES	YES	49.5	48.7	± 1.5	passed
1000	20.7	2.9	YES	0.0	YES	YES	YES	47.7	47.7	± 1.5	passed
1250	21.0	2.6	YES	0.0	YES	YES	YES	48.2	48.8	± 1.5	passed
1600	21.0	2.8	YES	0.0	YES	YES	YES	42.5	43.5	± 1.5	passed
2000	21.1	2.5	YES	0.0	YES	YES	YES	39.5	40.7	± 1.5	c
2500	20.8	1.6	YES	0.0	YES	YES	YES	43.2	44.5	± 1.5	passed
3150	20.6	1.9	YES	0.0	YES	YES	YES	37.1	38.3	± 1.5	c
4000	20.3	2.6	YES	0.0	YES	YES	YES	37.0	38.0	± 1.5	c
5000	19.9	2.6	YES	0.0	YES	YES	YES	35.7	36.2	± 1.5	c
6300	19.9	5.0	YES	0.0	YES	YES	YES	32.3	32.2	± 2.5	c
Total								**66.1**	**58.1**	**± 1.5**	

Legend:

passed	*Frequency bands with this description are significant for the calculation of A-weighted total sound power level L_{WA}. Required accuracy class is fulfilled in this band.*
not passed	*Frequency bands with this description are significant for the calculation of A-weighted total sound power level L_{WA}. Required accuracy class is not fulfilled in this band.*
c	*Frequency bands with this description are not significant for the calculation of A-weighted total sound power level L_{WA}. These bands are evaluated in the calculation of L_{WA}.*
nc	*Frequency bands with this description are not significant for the calculation of A-weighted total sound power level L_{WA}. These bands are not evaluated in the calculation of L_{WA}.*

Spectrum of Sound power level L_W – one-third octave bands

Air/Water Heat pump **HPR 500 DELUXE** Outdoor unit at A7/W55; on/off	**Engineering** **(Grade 2)**



Tested by:	Ing. Ondrej Bilkovič	Date:	2024-06-27	Signed:
Reviewed and approved by:	Ing. Antonín Kolbábek, Ph.D.	Date:	2024-06-27	Signed:

V. A list of referenced documents

- Order of 2024-04-26 (Order reg. no. B-82131, received on 2024-04-29)
- Contract B-82131/39

- ČSN EN 12102-1:2023 - Air conditioners, liquid chilling packages, heat pumps, process chillers and dehumidifiers with electrically driven compressors - Determination of the sound power level - Part 1: Air conditioners, liquid chilling packages, heat pumps for space heating and cooling, dehumidifiers and process chillers
- ČSN ISO 9614-2:1997 - Acoustics - Determination of sound power levels of noise sources using sound intensity - Part 2: Measurement by scannig

- ČSN EN 14511-2:2023 - Air conditioners, liquid chilling packages and heat pumps for space heating and cooling and process chillers, with electrically driven compressors - Part 2: Test conditions
- ČSN EN 14511-3:2023 - Air conditioners, liquid chilling packages and heat pumps for space heating and cooling and process chillers, with electrically driven compressors - Part 3: Test methods
- ČSN EN 14511-4:2023 - Air conditioners, liquid chilling packages and heat pumps for space heating and cooling and process chillers, with electrically driven compressors - Part 4: Requirements
- ČSN EN 14825:2023 - Air conditioners, liquid chilling packages and heat pumps, with electrically driven compressors, for space heating and cooling, commercial and process cooling - Testing and rating at part load conditions and calculation of seasonal performance

- Background of the SZU task no. 39-17727
- Record measurement file 39-17727-H.zip

Test Report compiled by: **Ing. Ondrej Bilkovič**
Test engineer

Accredited Testing Laboratory No. 1045.1 * STROJÍRENSKÝ ZKUŠEBNÍ ÚSTAV, s.p. * 1

Test Report approved by: **Ing. Antonín Kolbábek, Ph.D.**
Hydraulic and Pressure Equipment Manager

– End of Test Report –

TEST REPORT
39-17762/T_shortened

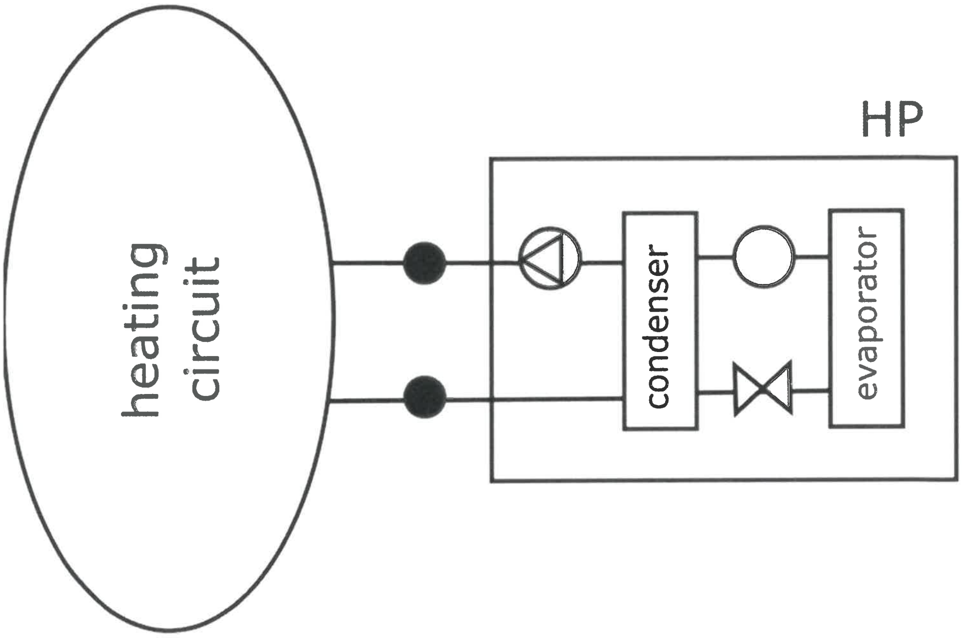
Product:	Outdoor Air/Water Heat Pump - Monobloc
Type designation:	HPR 500 DELUXE
Customer:	PPH Kostrzewa sp.k. Przemysłowa 11A 11-500 Giżycko POLAND
Manufacturer:	PPH Kostrzewa sp.k. Przemysłowa 11A 11-500 Giżycko POLAND
Report issue date:	2024-06-10
Distribution list:	1 copy to the Customer 1 copy to the Engineering Test Institute

I. Description of product tested

The Heat pump **HPR 500 DELUXE** supplied by the company **PPH KOSTRZEWA Sp.k.** is structurally adapted to operate in air/water system. Device is designed as monobloc placed outdoor. Refrigerant R290 is used with charge 0.95 kg. Power supply is a three-phase. Heat pump is able to work in heating and cooling mode. Heat pump is working with variable flow rate.

Main components of the outdoor unit **HPR 500 DELUXE**:
- Serial number 500143
- Refer to report 39-17488/T of 2024-03-21

Scheme:



II. Sample tested

SZU reg. no.	Product name	Date of submission
1212.24.39619.001	**HPR 500 DELUXE**	2024-02-29

The visual inspection, tests and verification were carried out by Ing. Tomáš Sedláček and Ing. Jakub Čederle at the test station of SZU.
The tests were performed using measuring and testing equipment with valid calibration.

III. Measuring and test equipment:

No.	Description:	Inventory number:
1.	Electrical energy meter	E3.1
2.	Digital watt meter	1.2.3 ENERGIE ANALYZATOR_3
3.	Flow meter Krohne Optiflux	8.1.5 TECH_K3_V_DN15_SEK
4.	Barometer	2.4 MAR18_1_PB
5.	Differential pressure gauge	14.2.2 MAR18_3_dP_2
6.	Temperature-humidity meter HF532	14.1.1 K3_VLHKOST_1
7.	Temperature-humidity meter HF532	14.1.3 K3_VLHKOST_2
8.	Thermometers	14.4 MAR18_T

IV. Methods, results of tests and verifications

No.	Test objective	Requirement	Method of test	Documentation	Test evaluation/ verification *
1.	Seasonal performance tests and SCOP calculation – Low temperature application	–	ČSN EN 14511-3:2023 ČSN EN 14825:2023	Page No. 5-11	x
2.	Seasonal performance tests and SCOP calculation – Medium temperature application	–	ČSN EN 14511-3:2023 ČSN EN 14825:2023	Page No. 12-18	x

***) Evaluation / statement of conformity:**
+...... Requirement fulfilled
-....... Requirement not fulfilled
0 ......Not applicable
x ......Not evaluated

Measured quantity	Unit	Uncertainty of measurement	Evaluation
Liquid			
- temperature difference (dT)	[K]	± 0.15 K	fulfilled
- temperature inlet/outlet	[°C]	± 0.15 K	fulfilled
- volume flow	[m3/s]	± 1 %	fulfilled
- static pressure difference	[kPa]	± 1 kPa (Δp ≤ 20 kPa) or ± 5 % (Δp > 20 kPa)	fulfilled
Air			
- dry bulb temperature	[°C]	± 0.2 K	fulfilled
- wet bulb temperature	[°C]	± 0.4 K	fulfilled
- volume flow	[m3/s]	± 5 %	not applied
- static pressure difference	[Pa]	± 5 Pa (Δp ≤ 100 Pa) or ± 5 % (Δp > 100 Pa)	not applied
Refrigerant			
- pressure at compressor outlet	[kPa]	± 1 %	not applied
- temperature	[°C]	± 0.5 K	not applied
Concentration (in volume)			
- heat transfer medium	[%]	± 2	not related
Electrical quantities			
- electric power	[W]	± 1 %	fulfilled
- voltage	[V]	± 0.5 %	fulfilled
- current	[A]	± 0.5 %	fulfilled
- electric energy	[kWh]	± 1 %	not applied
Compressor rotational speed	[min-1]	± 0.5 %	not applied
The heating or cooling capacities measured on the liquid side shall be determined within a maximum uncertainty of 5 % independent of the individual uncertainties of measurement including the uncertainties on the properties of fluids.			fulfilled

Note:
The stated extended measurement uncertainties are calculated as a factor of the measurement uncertainty and the extension coefficient k=2, corresponding to the coverage certainty of 95% as regards standard classification.

If a statement of conformity is provided, the decision rule pursuant to ILAC-G8:09/2019, Art. 4.2.1 - binary statement for the simple acceptance rule shall apply.

Comment to abbreviated marking: e.g. A7/W35
A (air) 7 (input air, dry-bulb temperature in °C) / W (water), 35 (output heating water temperature in °C)

Test objective:	Seasonal performance tests and SCOP calculation – Low temperature application
Exact name of the test procedure:	**1.37* - Tests of leakage, pressure resistance, thermal and technical parameters, combustion efficiency, safety functions**
Test method:	ČSN EN 14511-3:2023, ČSN EN 14825:2023
Sample tested:	Heat pump **HPR 500 DELUXE**
Measuring equipment used:	see Chapter III

Design	Air / water – monobloc				
Conditions specification according to ČSN EN 14825:2020	Temperature application			**Low** (reference water temperature 35 °C)	
	Reference heating season			**Average**	
	Outlet water temperature - indoor heat exchanger			Variable	
	Compressor speed control			Fixed	
	Water flow rate – primary circuit			–	
	Water flow rate – secondary circuit			Variable	
Seasonal space heating energy efficiency	Heating	Average	η_s	<u>158.3</u>	%
		Warmer	η_s	–	%
		Colder	η_s	–	%
Seasonal efficiency according to ČSN EN 14825:2020	Heating	Average	**SCOP**	<u>4.03</u>	–
		Warmer	SCOP	–	–
		Colder	SCOP	–	–
Function	Cooling			Yes	
	Heating	Yes, Reference heating season	Average	Yes	
			Warmer	Yes	
			Colder	Yes	
Full heating load	Cooling		$P_{designc}$	–	kW
	Heating	Average	$P_{designh}$	<u>10.39</u>	kW
		Warmer	$P_{designh}$	–	kW
		Colder	$P_{designh}$	–	kW
Bivalent temperatures	Heating	Average	$T_{bivalent}$	-7	°C
		Warmer	$T_{bivalent}$	–	°C
		Colder	$T_{bivalent}$	–	°C
Operation limit temperatures	Heating	Average	TOL	-10	°C
		Warmer	TOL	–	°C
		Colder	TOL	–	°C
Seasonal power consumption according to ČSN EN 14825:2020	Cooling		Q_{CE}	–	kWh
	Heating	Average	Q_{HE}	5323	kWh
		Warmer	Q_{HE}	–	kWh
		Colder	Q_{HE}	–	kWh
Modes other than „active mode"		Off mode	P_{OFF}	9.5	W
		Thermostat off mode	P_{TO}	12.8	W
		Standby mode	P_{SB}	12.7	W
		Crankcase heater mode	P_{CK}	0.0	W

Calculation of SCOP according to ČSN EN 14825:2023:

Number of hours used for calculation of reference SCOP (Annex B – Table B. 2, B. 3)

- For reversible heat pumps and reference heating season „A“ = average

H_{HE}	2066	[h]
H_{TO}	178	[h]
H_{SB}	0	[h]
H_{CK}	178	[h]
H_{OFF}	0	[h]

Measured data:

P_{TO}	0.0128	[kW]
P_{SB}	0.0127	[kW]
P_{CK}	0.0000	[kW]
P_{OFF}	0.0095	[kW]
$P_{designh}$	10.39	[kW]
$SCOP_{ON}$	4.03	[–]

Coefficient and correction:

F(1)	3	[%]
F(2)	0	[%]
CC	2.5	[–]

Calculation of SCOP:

7.3 Calculation of the reference annual heating demand (Q_H)

$Q_H = P_{designh} \cdot H_{HE}$ [kWh]

$Q_H = 10.39 \cdot 2066 = 21470$ [kWh]

7.4 Calculation of the annual electricity consumption (Q_{HE})

$Q_{HE} = Q_H / SCOP_{on} + H_{TO} \cdot P_{TO} + H_{SB} \cdot P_{SB} + H_{CK} \cdot P_{CK} + H_{OFF} \cdot P_{OFF}$ [kWh]

$Q_{HE} = 21470 / 4.03 + 178 \cdot 0.0128 + 0 \cdot 0.0127 + 178 \cdot 0 + 0 \cdot 0.0095 = 5323$ [kWh]

7.2 General formula for calculation of reference SCOP

$SCOP = Q_H / Q_{HE}$ [–]

$SCOP = 21470 / 5323 = 4.03$ [–]

7.1 Calculation of the seasonal space heating efficiency η_s

$\Sigma F(i) = F(1) + F(2)$ [–]

$\Sigma F = 0.03 + 0 = 0.03$ [–]

$\eta_s = 1 / CC \cdot SCOP - \Sigma F(i)$ [–]

$\eta_s (A) = (1 / 2.5) \cdot 4.03 – 0.03 = \underline{\mathbf{1.583}}$ [–]

Temperature level		Low (reference water temperature 35 °C)		
Reference heating season		„A" = average ($T_{designh}$ = -10 °C)		
Assessment condition		**A, Tbiv (F)**	**B**	**C**
Specification of the assessment condition*		**A-7/W34**	**A2/W32.23**	**A7/W30.65**
Date of testing		**2024-03-04**	**2024-03-06**	**2024-03-07**
Transient test procedure	YES / NO	NO	YES	NO
Average defrost time of 1 cycle	[min]	–	4.5	–
Average time of 1 cycle	[min]	–	104.9	–
Calculation time	[min]	70.0	104.9	70.0
Output heating water – temperature calculation	[°C]	33.98	31.82	30.62
Input heating water – temperature calculation	[°C]	28.99	27.33	25.64
Output heating water temperature	[°C]	33.98	32.31	30.62
Input heating water temperature	[°C]	28.99	27.32	25.64
Air temperature – dry bulb temperature	[°C]	-7.00	1.85	7.00
Air temperature – wet bulb temperature	[°C]	-8.02	0.92	6.02
Relative humidity	[%]	74.69	84.82	87.08
Barometric pressure	[kPa]	97.634	98.809	98.925
Ambient temperature	[°C]	-6.72	2.38	7.56
Secondary circuit pressure difference	[kPa]	-48.973	-38.807	-13.971
Efficiency of the secondary liquid pump	[–]	0.307	0.302	0.221
Volume flow rate of heating water	[$m^3 \cdot h^{-1}$]	1.5877	1.9008	2.3182
Density of heating water	[$kg \cdot m^{-3}$]	994.3	994.9	995.3
Specific heat capacity of heating water	[$kJ \cdot kg^{-1} \cdot K^{-1}$]	4.175	4.176	4.177
Voltage	[V]	403.30	401.85	401.75
Total current	[A]	19.63	19.22	19.22
Overall power input	[kW]	2.729	2.615	2.617
Capacity correction of sec. liquid pump	[W]	-44.836	-47.363	-31.794
Power input correction of sec. liquid pump	[W]	-66.41	-67.88	-40.79
Heating capacity – heating water	[kW]	9.148	10.030	13.333
Corrected heating capacity – heating water	**[kW]**	**9.193**	**10.077**	**13.365**
Uncertainty of corrected heating capacity	[kW]	± 0.160	± 0.191	± 0.234
Effective electric power input	**[kW]**	**2.795**	**2.683**	**2.658**
COP	**[–]**	**3.289**	**3.756**	**5.029**
Uncertainty of COP	[–]	± 0.058	± 0.072	± 0.089
Control settings	**[–]**	–	–	–
Circulation pump settings – heating water	[–]	–	–	–

Temperature level		Low (reference water temperature 35 °C)	
Reference heating season		„A“ = average ($T_{designh}$ = -10 °C)	
Assessment condition		**D**	**TOL (E)**
Specification of the assessment condition*		**A12/W28.48**	**A-10/W35**
Date of testing		**2024-03-08**	**2024-03-05**
Transient test procedure	YES / NO	NO	NO
Average defrost time of 1 cycle	[min]	–	–
Average time of 1 cycle	[min]	–	–
Calculation time	[min]	70.0	70.0
Output heating water – temperature calculation	[°C]	28.47	35.00
Input heating water – temperature calculation	[°C]	23.47	30.00
Output heating water temperature	[°C]	28.47	35.00
Input heating water temperature	[°C]	23.47	30.00
Air temperature – dry bulb temperature	[°C]	11.99	-10.01
Air temperature – wet bulb temperature	[°C]	11.00	-10.90
Relative humidity	[%]	89.02	72.83
Barometric pressure	[kPa]	98.892	98.397
Ambient temperature	[°C]	12.58	-9.71
Secondary circuit pressure difference	[kPa]	-18.396	-10.337
Efficiency of the secondary liquid pump	[–]	0.260	0.166
Volume flow rate of heating water	[$m^3 \cdot h^{-1}$]	2.6539	1.4608
Density of heating water	[$kg \cdot m^{-3}$]	995.9	994.0
Specific heat capacity of heating water	[$kJ \cdot kg^{-1} \cdot K^{-1}$]	4.178	4.175
Voltage	[V]	400.75	402.52
Total current	[A]	19.25	19.47
Overall power input	[kW]	2.634	2.671
Capacity correction of sec. liquid pump	[W]	-38.510	-21.079
Power input correction of sec. liquid pump	[W]	-52.07	-25.27
Heating capacity – heating water	[kW]	15.333	8.416
Corrected heating capacity – heating water	**[kW]**	**15.372**	**8.437**
Uncertainty of corrected heating capacity	[kW]	± 0.268	± 0.147
Effective electric power input	**[kW]**	**2.686**	**2.696**
COP	**[–]**	**5.722**	**3.129**
Uncertainty of COP	[–]	± 0.102	± 0.055
Control settings	**[–]**	–	–
Circulation pump settings – heating water	[–]	–	–

Data for SCOP calculation

- Low temperature application (reference water temperature 35 °C)
- Reference heating season „A" – average

	Outdoor heat exchanger	Indoor heat exchanger	Part load ratio	Part load	DC Declared capacity	COPd at declared capacity	Cdh degradation coefficient	CR	COPbin (Tj)	Eff. power input of compressor off state
	Outdoor air inlet	Outlet water temperature								
	[°C]	[°C]	[%]	[kW]	[kW]	[–]	[–]	[–]	[–]	[kW]
A	-7	34.00	88.46	9.19	9.193	3.289	0.900	1.00	3.289	–
B	2	32.22	53.85	5.60	10.077	3.756	0.995	0.56	3.742	0.0128
C	7	30.65	34.62	3.60	13.365	5.029	0.995	0.27	4.964	0.0128
D	12	28.48	15.38	1.60	15.372	5.722	0.995	0.10	5.496	0.0128
TOL (E)	-10	35.00	100.00	10.39	8.437	3.129	0.900	1.23	3.129	–
Tbiv (F)	-7	34.00	88.46	9.19	9.193	3.289	0.900	1.00	3.289	–

Adaption of water temperature – according to ČSN EN 14825:2023, Annex F

- Low temperature application (reference water temperature 35 °C)
- Reference season „A"– average
- Condition D
- Variable water flow rate – secondary circuit

General formulas and derivation:

$t_{\text{outlet, average}} = t_{\text{inlet, capacity test}} + (t_{\text{outlet, capacity test}} - t_{\text{inlet, capacity test}}) \cdot CR$ [°C]

$t_{\text{outlet, average}} = t_{\text{inlet, capacity test}} + (\Delta t) \cdot CR$ [°C]

$t_{\text{outlet, average}} = t_{\text{outlet, capacity test}} - \Delta t + \Delta t \cdot CR$ [°C]

$t_{\text{outlet, capacity test}} = t_{\text{outlet, average}} + \Delta t - \Delta t \cdot CR$ [°C]

For variable flow:

$\Delta t = 5$

$CR \cdot \Delta t$ = Part load / Declared capacity $\cdot$ 5

$t_{\text{outlet, capacity test, variable flow}} = t_{\text{outlet, average}} + 5$ - Part load / Declared capacity · 5

Measured data:

$t_{\text{outlet, average}}$	24.00	[°C]
Declared capacity	15.372	[kW]
Declared capacity $_{\text{standard rating condition A7/W35}}$	-	[kW]
Part load	1.60	[kW]

Calculation of water temperature

$t_{\text{outlet, capacity test, variable flow}} = 24 + 5 – 1.6 / 15.372 \cdot 5 = \underline{\mathbf{28.48}}$ [°C]

Calculation SCOP, $SCOP_{on}$, $SCOP_{net}$

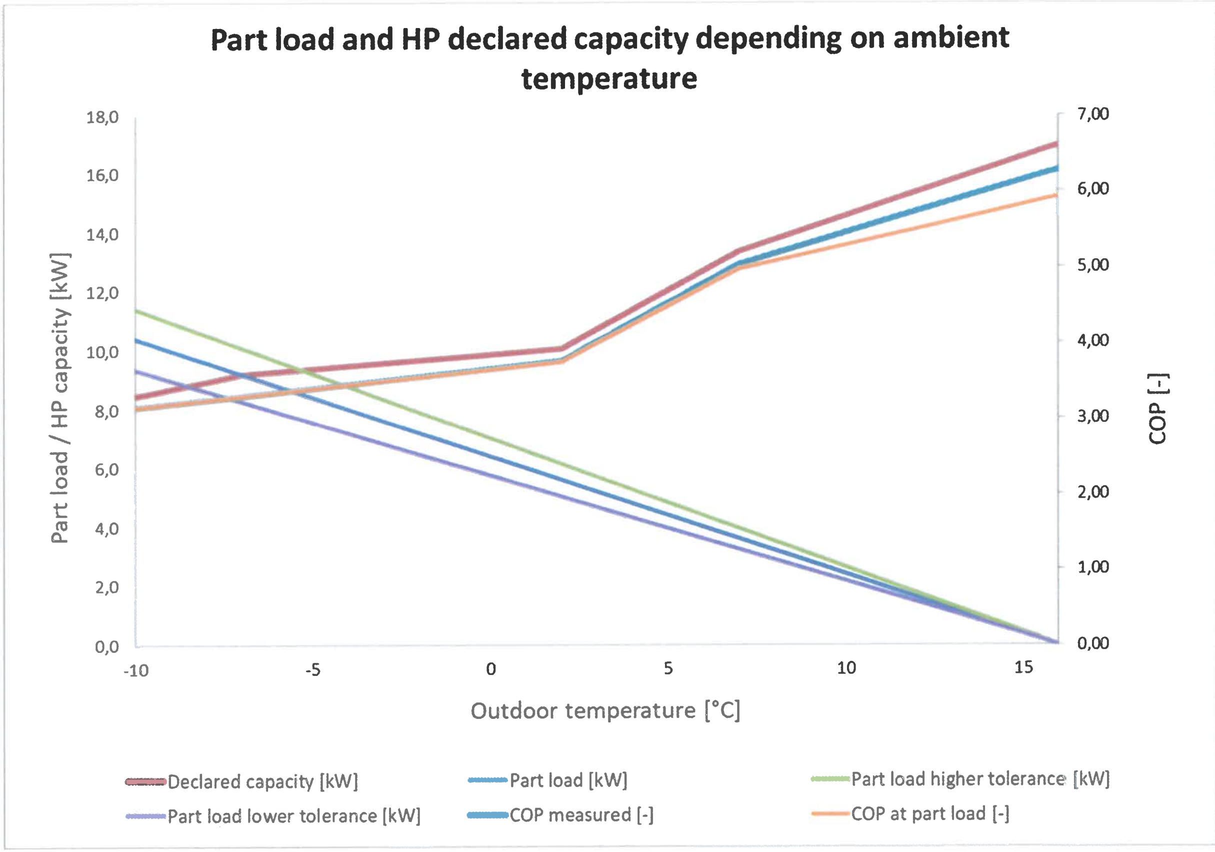
- Low temperature application (reference water temperature 35 °C)
- Reference heating season „A“ – average

	Bin j [–]	Outdoor temp. (dry bulb) Tj [°C]	Hours hj [h]	Part load ratio [%]	Heat load Ph(Tj) [kW]	Capacity of HP [kW]	Heat load covered by heat pump [kW]	Resistive heat elbu (Tj) elbu(Tj) [kW]	Annual resistive heat hj x elbu(Tj) [kWh]	COPbin (Tj) COPb in (Tj) [–]	Annual heating demand hj x P h(Tj) [kWh]	Annual power input including electric back up heating [kWh]	Net annual heating capacity hj × (P h(Tj) - elbu(Tj)) [kWh]	Net annual power input without electric back up heating [kWh]
TOL(E)	**21**	**-10**	**1**	**100.00**	**10.39**	**8.44**	**8.44**	**1.96**	**1.96**	**3.13**	**10**	**5**	**8**	**3**
	22	-9	25	96.15	9.99	8.69	8.69	1.30	32.58	3.18	250	101	217	68
	23	-8	23	92.31	9.59	8.94	8.94	0.65	14.99	3.24	221	79	206	64
A, Tbiv(F)	**24**	**-7**	**24**	**88.46**	**9.19**	**9.19**	**9.19**	**0.00**	**0.00**	**3.29**	**221**	**67**	**221**	**67**
	25	-6	27	84.62	8.79	9.29	8.79	0.00	0.00	3.34	237	71	237	71
	26	-5	68	80.77	8.39	9.39	8.39	0.00	0.00	3.39	571	168	571	168
	27	-4	91	76.92	7.99	9.49	7.99	0.00	0.00	3.44	727	211	727	211
	28	-3	89	73.08	7.59	9.59	7.59	0.00	0.00	3.49	676	194	676	194
	29	-2	165	69.23	7.19	9.68	7.19	0.00	0.00	3.54	1187	335	1187	335
	30	-1	173	65.38	6.79	9.78	6.79	0.00	0.00	3.59	1176	327	1176	327
	31	0	240	61.54	6.40	9.88	6.40	0.00	0.00	3.64	1535	422	1535	422
	32	1	280	57.69	6.00	9.98	6.00	0.00	0.00	3.69	1679	455	1679	455
B	**33**	**2**	**320**	**53.85**	**5.60**	**10.08**	**5.60**	**0.00**	**0.00**	**3.74**	**1791**	**479**	**1791**	**479**
	34	3	357	50.00	5.20	10.73	5.20	0.00	0.00	3.99	1855	465	1855	465
	35	4	356	46.15	4.80	11.39	4.80	0.00	0.00	4.23	1707	404	1707	404
	36	5	303	42.31	4.40	12.05	4.40	0.00	0.00	4.48	1332	298	1332	298
	37	6	330	38.46	4.00	12.71	4.00	0.00	0.00	4.72	1319	279	1319	279
C	**38**	**7**	**326**	**34.62**	**3.60**	**13.37**	**3.60**	**0.00**	**0.00**	**4.96**	**1173**	**236**	**1173**	**236**
	39	8	348	30.77	3.20	13.77	3.20	0.00	0.00	5.07	1113	219	1113	219
	40	9	335	26.92	2.80	14.17	2.80	0.00	0.00	5.18	937	181	937	181
	41	10	315	23.08	2.40	14.57	2.40	0.00	0.00	5.28	755	143	755	143
	42	11	215	19.23	2.00	14.97	2.00	0.00	0.00	5.39	430	80	430	80
D	**43**	**12**	**169**	**15.38**	**1.60**	**15.37**	**1.60**	**0.00**	**0.00**	**5.50**	**270**	**49**	**270**	**49**
	44	13	151	11.54	1.20	15.77	1.20	0.00	0.00	5.60	181	32	181	32
	45	14	105	7.69	0.80	16.17	0.80	0.00	0.00	5.71	84	15	84	15
	46	15	74	3.85	0.40	16.58	0.40	0.00	0.00	5.82	30	5	30	5
		Σ	4910							Σ	21466	5320	21417	5271

SCOPon	4.03	SCOPnet	4.06
		SCOP	**4.03**

Part load performance diagram

- Low temperature application (reference water temperature 35 °C)
- Reference heating season „A" – average



Test objective:	Seasonal performance tests and SCOP calculation – Medium temperature application
Exact name of the test procedure:	**1.37* - Tests of leakage, pressure resistance, thermal and technical parameters, combustion efficiency, safety functions**
Test method:	ČSN EN 14511-3:2023, ČSN EN 14825:2023
Sample tested:	Heat pump **HPR 500 DELUXE**
Measuring equipment used:	see Chapter III

Design	Air / water – monobloc				
Conditions specification according to ČSN EN 14825:2020	Temperature application			**Medium** (reference water temperature 55 °C)	
	Reference heating season			**Average**	
	Outlet water temperature - indoor heat exchanger			Variable	
	Compressor speed control			Fixed	
	Water flow rate – primary circuit			–	
	Water flow rate – secondary circuit			Variable	
Seasonal space heating energy efficiency	Heating	Average	η_s	132.6	%
		Warmer	η_s	–	%
		Colder	η_s	–	%
Seasonal efficiency according to ČSN EN 14825:2020	Heating	Average	**SCOP**	3.39	–
		Warmer	SCOP	–	–
		Colder	SCOP	–	–
Function	Cooling			Yes	
	Heating	Yes	Reference heating season: Average	Yes	
			Warmer	Yes	
			Colder	Yes	
Full heating load	Cooling		$P_{designc}$	–	kW
	Heating	Average	$P_{designh}$	9.99	kW
		Warmer	$P_{designh}$	–	kW
		Colder	$P_{designh}$	–	kW
Bivalent temperatures	Heating	Average	$T_{bivalent}$	-7	°C
		Warmer	$T_{bivalent}$	–	°C
		Colder	$T_{bivalent}$	–	°C
Operation limit temperatures	Heating	Average	TOL	-10	°C
		Warmer	TOL	–	°C
		Colder	TOL	–	°C
Seasonal power consumption according to ČSN EN 14825:2020	Cooling		Q_{CE}	–	kWh
	Heating	Average	Q_{HE}	6089	kWh
		Warmer	Q_{HE}	–	kWh
		Colder	Q_{HE}	–	kWh
Modes other than „active mode“	Off mode		P_{OFF}	9.5	W
	Thermostat off mode		P_{TO}	12.8	W
	Standby mode		P_{SB}	12.7	W
	Crankcase heater mode		P_{CK}	0.0	W

Calculation of SCOP according to ČSN EN 14825:2023:

Number of hours used for calculation of reference SCOP (Annex B – Table B. 2, B. 3)

- For reversible heat pumps and reference heating season „A“ = average

H_{HE}	2066	[h]
H_{TO}	178	[h]
H_{SB}	0	[h]
H_{CK}	178	[h]
H_{OFF}	0	[h]

Measured data:

P_{TO}	0.0128	[kW]
P_{SB}	0.0127	[kW]
P_{CK}	0.0000	[kW]
P_{OFF}	0.0095	[kW]
$P_{designh}$	9.99	[kW]
$SCOP_{ON}$	3.39	[–]

Coefficient and correction:

F(1)	3	[%]
F(2)	0	[%]
CC	2.5	[–]

Calculation of SCOP:

7.3 Calculation of the reference annual heating demand (Q_H)

$Q_H = P_{designh} \cdot H_{HE}$ [kWh]

$QH = 9.99 \cdot 2066 = 20643$ [kWh]

7.4 Calculation of the annual electricity consumption (Q_{HE})

$Q_{HE} = Q_H / SCOP_{on} + H_{TO} \cdot P_{TO} + H_{SB} \cdot P_{SB} + H_{CK} \cdot P_{CK} + H_{OFF} \cdot P_{OFF}$ [kWh]

$QHE = 20643 / 3.39 + 178 \cdot 0.0128 + 0 \cdot 012718 + 178 \cdot 0 + 0 \cdot 0.0095 = 6089$ [kWh]

7.2 General formula for calculation of reference SCOP

$SCOP = Q_H / Q_{HE}$ [–]

$SCOP = 20643 / 6108 = 3.39$ [–]

7.1 Calculation of the seasonal space heating efficiency η_s

$\Sigma F(i) = F(1) + F(2)$ [–]

$\Sigma F = 0.03 + 0 = 0.03$ [–]

$\eta_s = 1 / CC \cdot SCOP - \Sigma F(i)$ [–]

$\eta_s (A) = (1 / 2.5) \cdot 3.39 – 0.03 = \underline{\mathbf{1.326}}$ [–]

Temperature level		Medium (reference water temperature 55 °C)		
Reference heating season		„A“ = average ($T_{designh}$ = -10 °C)		
Assessment condition		**A, Tbiv (F)**	**B**	**C**
Specification of the assessment condition*		**A-7/W52**	**A2/W45.75**	**A7/W41.91**
Date of testing		**2024-03-05**	**2024-03-06**	**2024-03-07**
Transient test procedure	YES / NO	NO	YES	NO
Average defrost time of 1 cycle	[min]	–	4.6	–
Average time of 1 cycle	[min]	–	132.0	–
Calculation time	[min]	70.0	132.0	70.0
Output heating water – temperature calculation	[°C]	52.00	45.23	41.87
Input heating water – temperature calculation	[°C]	44.00	37.85	33.87
Output heating water temperature	[°C]	52.00	45.81	41.87
Input heating water temperature	[°C]	44.00	37.83	33.87
Air temperature – dry bulb temperature	[°C]	-7.01	1.98	7.00
Air temperature – wet bulb temperature	[°C]	-8.01	1.00	6.01
Relative humidity	[%]	74.91	84.02	86.98
Barometric pressure	[kPa]	98.238	98.713	98.936
Ambient temperature	[°C]	-6.74	2.46	7.47
Secondary circuit pressure difference	[kPa]	-9.109	-12.304	-5.101
Efficiency of the secondary liquid pump	[–]	0.144	0.165	0.138
Volume flow rate of heating water	[$m^3 \cdot h^{-1}$]	0.9627	1.1958	1.4351
Density of heating water	[$kg \cdot m^{-3}$]	987.4	990.2	991.5
Specific heat capacity of heating water	[$kJ \cdot kg^{-1} \cdot K^{-1}$]	4.177	4.175	4.175
Voltage	[V]	401.76	402.01	400.67
Total current	[A]	21.51	20.90	20.63
Overall power input	[kW]	3.428	3.208	3.151
Capacity correction of sec. liquid pump	[W]	-14.528	-20.669	-12.659
Power input correction of sec. liquid pump	[W]	-16.96	-24.76	-14.69
Heating capacity – heating water	[kW]	8.825	10.109	13.198
Corrected heating capacity – heating water	**[kW]**	**8.839**	**10.130**	**13.211**
Uncertainty of corrected heating capacity	[kW]	± 0.100	± 0.124	± 0.150
Effective electric power input	**[kW]**	**3.445**	**3.232**	**3.166**
COP	**[–]**	**2.566**	**3.134**	**4.173**
Uncertainty of COP	[–]	± 0.029	± 0.039	± 0.048
Control settings	**[–]**	–	–	–
Circulation pump settings – heating water	[–]	–	–	–

Temperature level		Medium (reference water temperature 55 °C)	
Reference heating season		„A“ = average ($T_{designh}$ = -10 °C)	
Assessment condition		**D**	**TOL (E)**
Specification of the assessment condition*		**A12/W37.19**	**A-10/W55**
Date of testing		**2024-03-07**	**2024-03-05**
Transient test procedure	YES / NO	NO	NO
Average defrost time of 1 cycle	[min]	–	–
Average time of 1 cycle	[min]	–	–
Calculation time	[min]	70.0	70.0
Output heating water – temperature calculation	[°C]	37.11	55.01
Input heating water – temperature calculation	[°C]	29.11	47.01
Output heating water temperature	[°C]	37.11	55.01
Input heating water temperature	[°C]	29.11	47.01
Air temperature – dry bulb temperature	[°C]	12.01	-10.01
Air temperature – wet bulb temperature	[°C]	11.01	-10.83
Relative humidity	[%]	88.99	75.11
Barometric pressure	[kPa]	98.989	98.261
Ambient temperature	[°C]	12.58	-9.88
Secondary circuit pressure difference	[kPa]	-6.728	-10.404
Efficiency of the secondary liquid pump	[–]	0.152	0.146
Volume flow rate of heating water	[$m^3 \cdot h^{-1}$]	1.6387	0.8999
Density of heating water	[$kg \cdot m^{-3}$]	993.2	986.0
Specific heat capacity of heating water	[$kJ \cdot kg^{-1} \cdot K^{-1}$]	4.175	4.178
Voltage	[V]	401.05	401.40
Total current	[A]	20.11	21.77
Overall power input	[kW]	2.970	3.514
Capacity correction of sec. liquid pump	[W]	-17.131	-15.247
Power input correction of sec. liquid pump	[W]	-20.19	-17.85
Heating capacity – heating water	[kW]	15.102	8.237
Corrected heating capacity – heating water	**[kW]**	**15.119**	**8.252**
Uncertainty of corrected heating capacity	[kW]	± 0.172	± 0.094
Effective electric power input	**[kW]**	**2.990**	**3.532**
COP	**[–]**	**5.056**	**2.336**
Uncertainty of COP	[–]	± 0.058	± 0.027
Control settings	**[–]**	–	–
Circulation pump settings – heating water	[–]	–	–

Data for SCOP calculation

- Medium temperature application (reference water temperature 55 °C)
- Reference heating season „A“ – average

	Outdoor heat exchanger	Indoor heat exchanger	Part load ratio	Part load	DC Declared capacity	COPd at declared capacity	Cdh degradation coefficient	CR	COPbin (Tj)	Eff. power input of compressor off state
	Outdoor air inlet	Outlet water temperature								
	[°C]	[°C]	[%]	[kW]	[kW]	[–]	[–]	[–]	[–]	[kW]
A	-7	52.00	88.46	8.84	8.839	2.566	0.900	1.00	2.566	–
B	2	45.75	53.85	5.38	10.130	3.232	0.996	0.53	3.220	0.0128
C	7	41.91	34.62	3.46	13.211	4.173	0.996	0.26	4.126	0.0128
D	12	37.19	15.38	1.54	15.119	5.056	0.996	0.10	4.872	0.0128
TOL (E)	-10	55.00	100.00	9.99	8.252	2.336	0.900	1.21	2.336	–
Tbiv (F)	-7	52.00	88.46	8.84	8.839	2.566	0.900	1.00	2.566	–

Adaption of water temperature – according to ČSN EN 14825:2023, Annex F

- Medium temperature application (reference water temperature 55 °C)
- Reference season „A“– average
- Condition D
- Variable water flow rate – secondary circuit

General formulas and derivation:

$t_{\text{outlet, average}} = t_{\text{inlet, capacity test}} + (t_{\text{outlet, capacity test}} - t_{\text{inlet, capacity test}}) \cdot CR$ [°C]

$t_{\text{outlet, average}} = t_{\text{inlet, capacity test}} + (\Delta t) \cdot CR$ [°C]

$t_{\text{outlet, average}} = t_{\text{outlet, capacity test}} - \Delta t + \Delta t \cdot CR$ [°C]

$t_{\text{outlet, capacity test}} = t_{\text{outlet, average}} + \Delta t - \Delta t \cdot CR$ [°C]

For variable flow:

$\Delta t = 8$

$CR \cdot \Delta t$ = Part load / Declared capacity $\cdot$ 8

$\mathbf{t_{\text{outlet, capacity test, variable flow}} = t_{\text{outlet, average}} + 8}$ **- Part load / Declared capacity · 8**

Measured data:

$t_{\text{outlet, average}}$	30.00	[°C]
Declared capacity	15.119	[kW]
Declared capacity $_{\text{standard rating condition A7/W55}}$	-	[kW]
Part load	1.54	[kW]

Calculation of water temperature

$t_{\text{outlet, capacity test, variable flow}} = 30 + 8 - 1.54 / 15.119 \cdot 8 = \underline{\mathbf{37.19}}$ [°C]

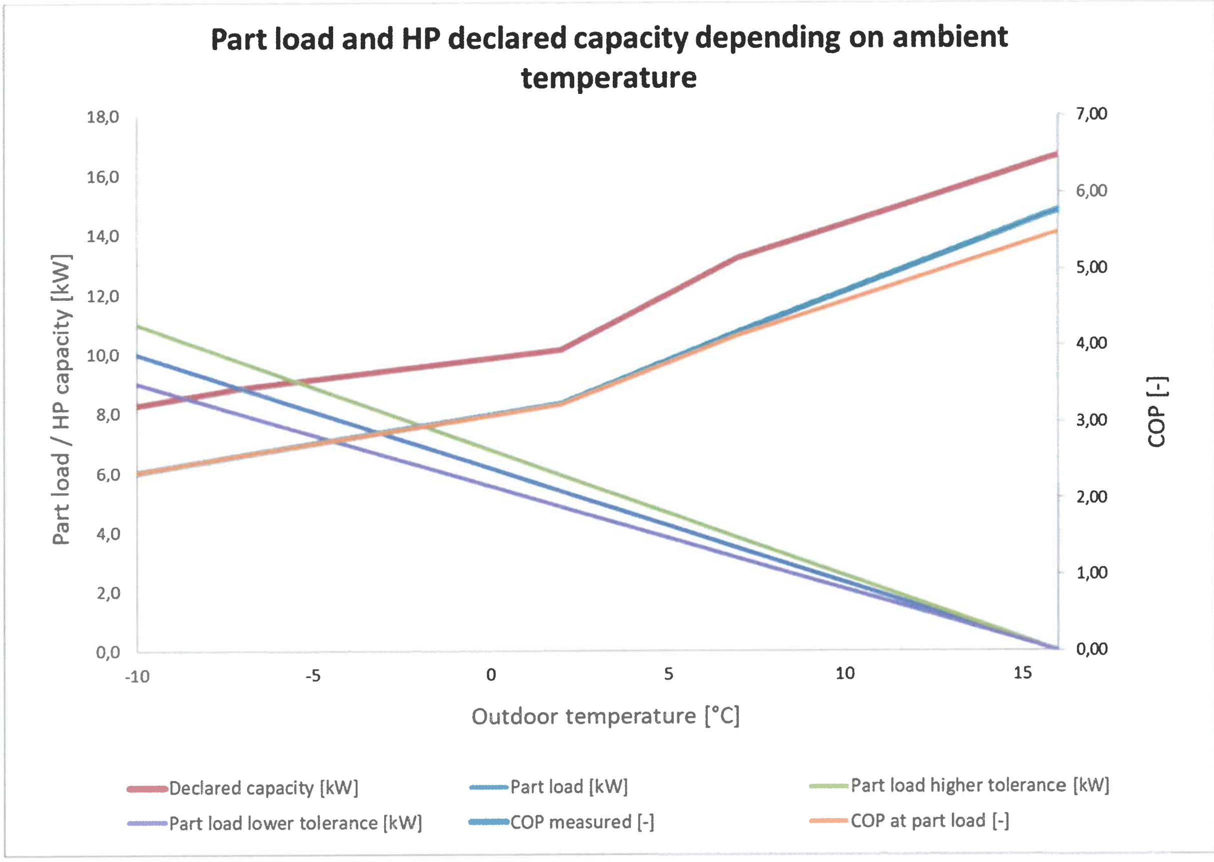
Calculation SCOP, $SCOP_{on}$, $SCOP_{net}$

- Medium temperature application (reference water temperature 55 °C)
- Reference heating season „A“ – average

	Bin j [–]	Outdoor temp. (dry bulb) Tj [°C]	Hours hj [h]	Part load ratio [%]	Heat load Ph(Tj) [kW]	Capacity of HP [kW]	Heat load covered by heat pump [kW]	Resistive heat elbu (Tj) elbu(Tj) [kW]	Annual resistive heat hj x elbu(Tj) [kWh]	COPbin (Tj) COPb in (Tj) [–]	Annual heating demand hj x P h(Tj) [kWh]	Annual power input including electric back up heating [kWh]	Net annual heating capacity hj × (P h(Tj) - elbu(Tj)) [kWh]	Net annual power input without electric back up heating [kWh]
TOL(E)	**21**	**-10**	**1**	**100.00**	**9.99**	**8.25**	**8.25**	**1.74**	**1.74**	**2.34**	**10**	**5**	**8**	**4**
	22	-9	25	96.15	9.61	8.45	8.45	1.16	29.00	2.41	240	117	211	88
	23	-8	23	92.31	9.22	8.64	8.64	0.58	13.34	2.49	212	93	199	80
A, Tbiv(F)	**24**	**-7**	**24**	**88.46**	**8.84**	**8.84**	**8.84**	**0.00**	**0.00**	**2.57**	**212**	**83**	**212**	**83**
	25	-6	27	84.62	8.45	8.98	8.45	0.00	0.00	2.64	228	87	228	87
	26	-5	68	80.77	8.07	9.13	8.07	0.00	0.00	2.71	549	202	549	202
	27	-4	91	76.92	7.69	9.27	7.69	0.00	0.00	2.78	699	251	699	251
	28	-3	89	73.08	7.30	9.41	7.30	0.00	0.00	2.86	650	227	650	227
	29	-2	165	69.23	6.92	9.56	6.92	0.00	0.00	2.93	1141	390	1141	390
	30	-1	173	65.38	6.53	9.70	6.53	0.00	0.00	3.00	1130	376	1130	376
	31	0	240	61.54	6.15	9.84	6.15	0.00	0.00	3.07	1476	480	1476	480
	32	1	280	57.69	5.76	9.99	5.76	0.00	0.00	3.15	1614	513	1614	513
B	**33**	**2**	**320**	**53.85**	**5.38**	**10.13**	**5.38**	**0.00**	**0.00**	**3.22**	**1722**	**535**	**1722**	**535**
	34	3	357	50.00	5.00	10.75	5.00	0.00	0.00	3.40	1784	524	1784	524
	35	4	356	46.15	4.61	11.36	4.61	0.00	0.00	3.58	1642	458	1642	458
	36	5	303	42.31	4.23	11.98	4.23	0.00	0.00	3.76	1281	340	1281	340
	37	6	330	38.46	3.84	12.59	3.84	0.00	0.00	3.94	1268	321	1268	321
C	**38**	**7**	**326**	**34.62**	**3.46**	**13.21**	**3.46**	**0.00**	**0.00**	**4.13**	**1128**	**273**	**1128**	**273**
	39	8	348	30.77	3.07	13.59	3.07	0.00	0.00	4.28	1070	250	1070	250
	40	9	335	26.92	2.69	13.97	2.69	0.00	0.00	4.42	901	204	901	204
	41	10	315	23.08	2.31	14.36	2.31	0.00	0.00	4.57	726	159	726	159
	42	11	215	19.23	1.92	14.74	1.92	0.00	0.00	4.72	413	87	413	87
D	**43**	**12**	**169**	**15.38**	**1.54**	**15.12**	**1.54**	**0.00**	**0.00**	**4.87**	**260**	**53**	**260**	**53**
	44	13	151	11.54	1.15	15.50	1.15	0.00	0.00	5.02	174	35	174	35
	45	14	105	7.69	0.77	15.88	0.77	0.00	0.00	5.17	81	16	81	16
	46	15	74	3.85	0.38	16.26	0.38	0.00	0.00	5.32	28	5	28	5
		Σ	4910							Σ	20639	6086	20595	6041

SCOPon	3.39	SCOPnet	3.41
		SCOP	**3.39**

Part load performance diagram
- Medium temperature application (reference water temperature 55 °C)
- Reference heating season „A" – average

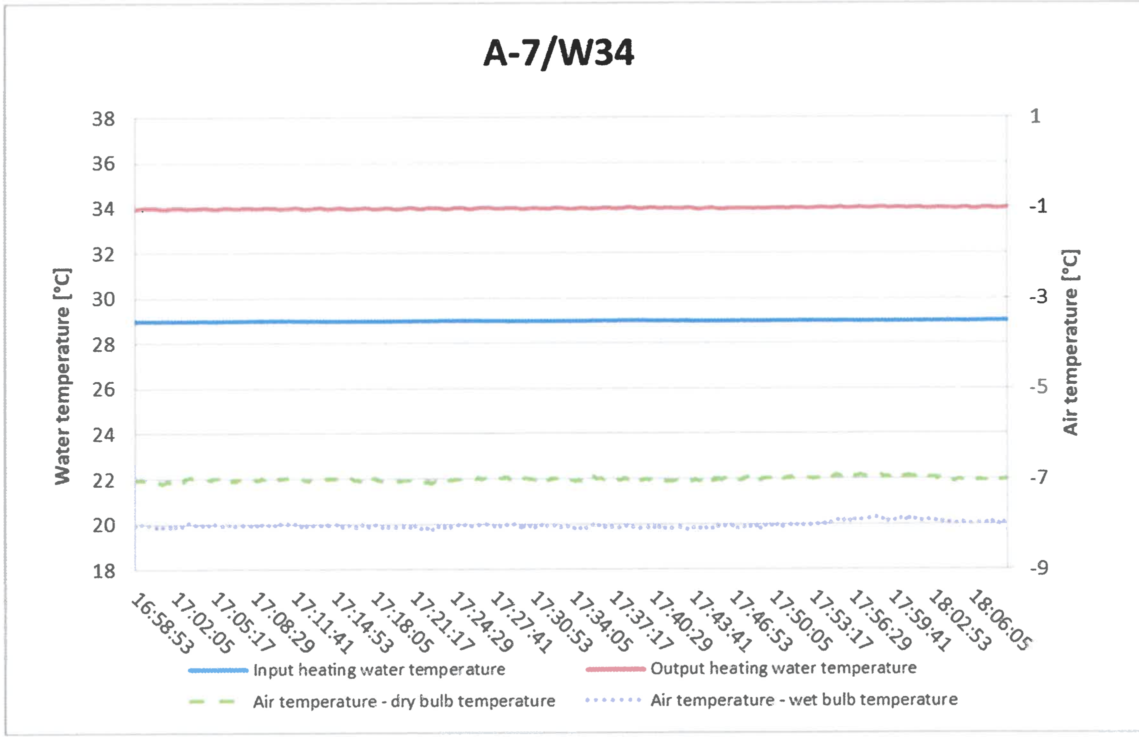


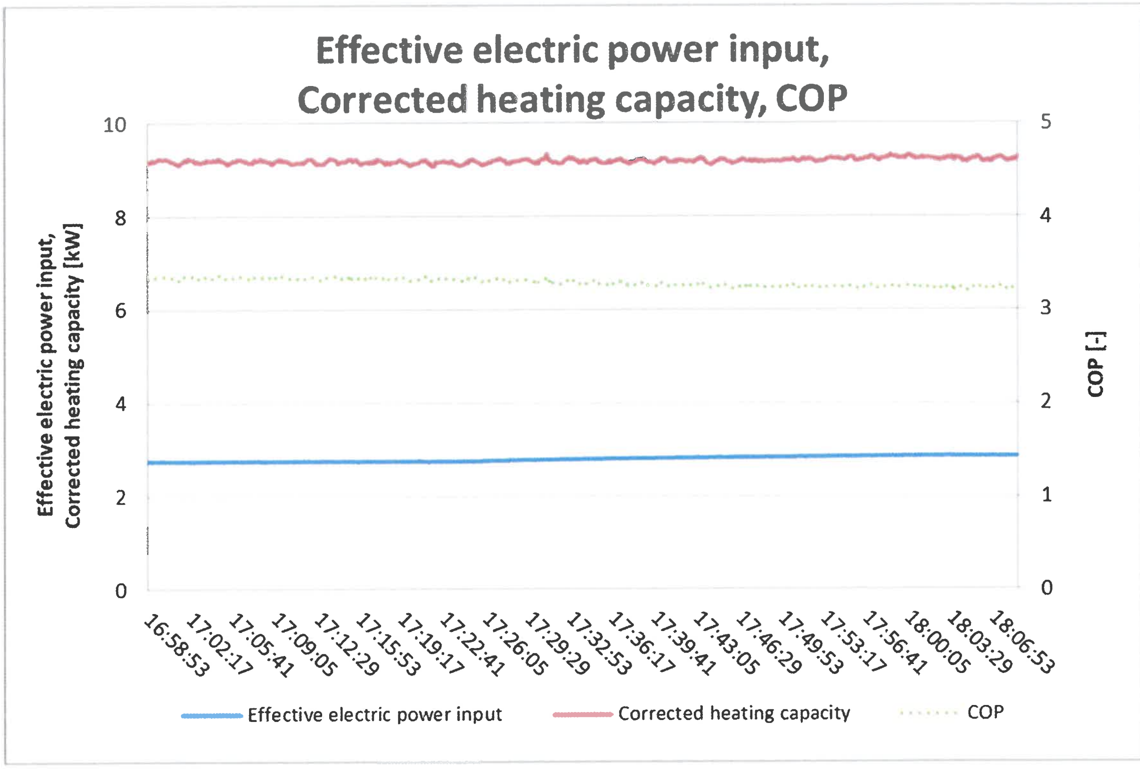
Tested by:	Ing. Jakub Čederle	Date:	2024-06-10	Signed:	
Reviewed and approved by:	Ing. Michal Faltýnek	Date:	2024-06-10	Signed:	

V. Graphs

1. Seasonal performance tests and SCOP calculation – Low temperature application

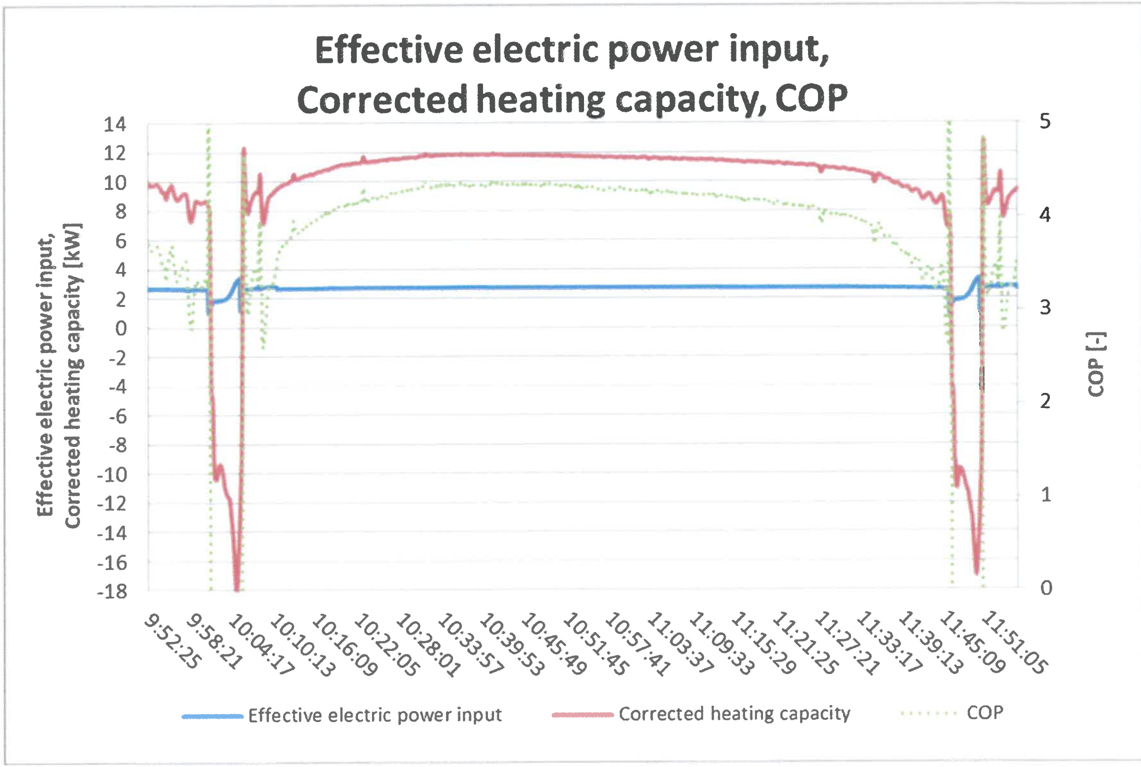
A-7/W34



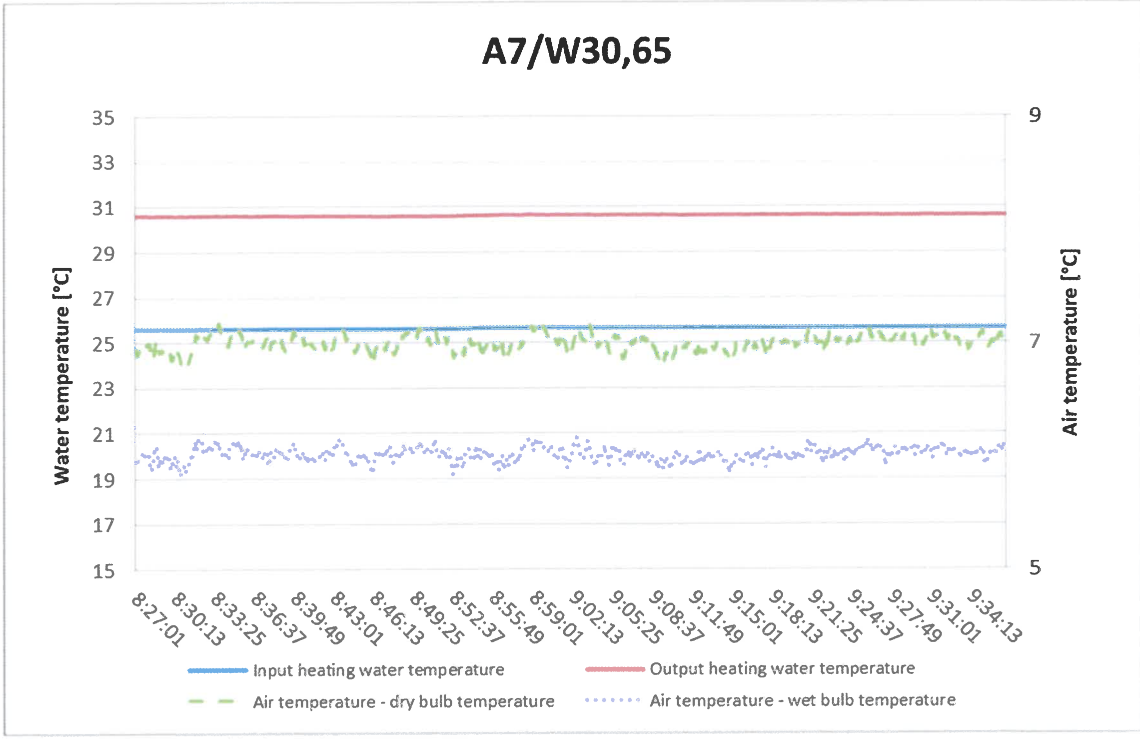


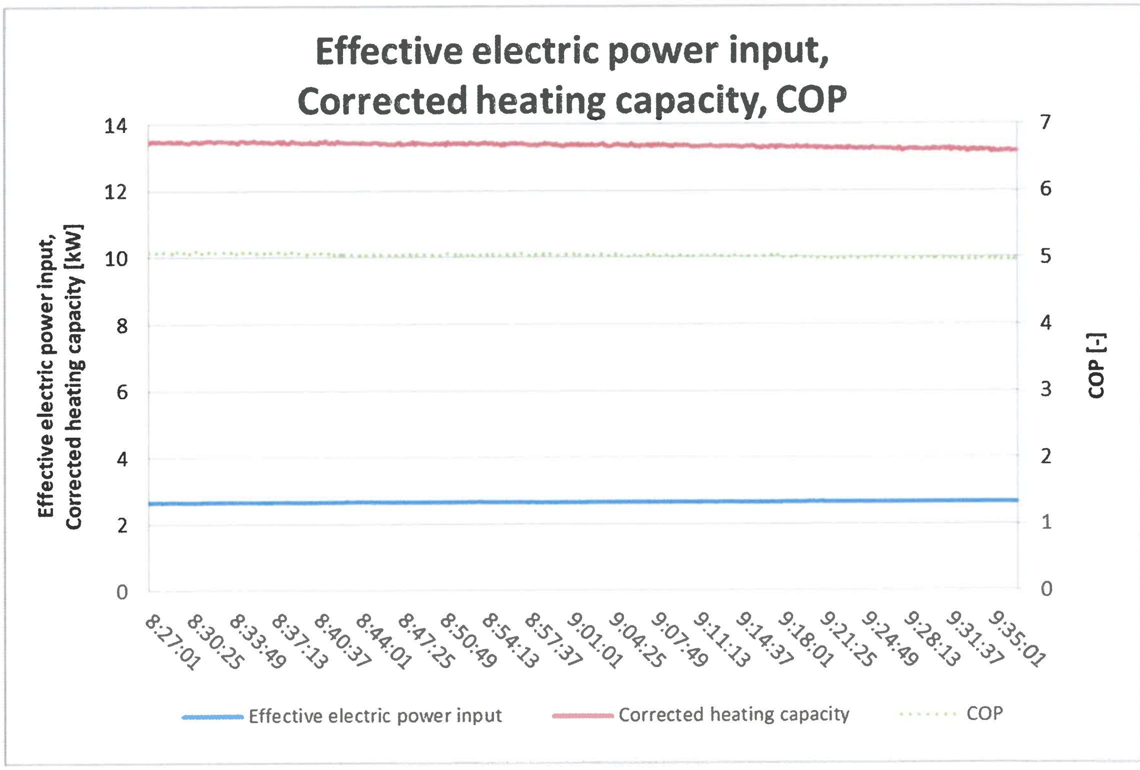
A2/W32.23


A2/W32,23
Water temperature [°C]
Air temperature [°C]
35
33
31
29
27
25
23
21
19
17
15
4
2
0
9:52:25
9:58:05
10:03:45
10:09:25
10:15:05
10:20:45
10:26:25
10:32:05
10:37:45
10:43:25
10:49:05
10:54:45
11:00:25
11:06:05
11:11:45
11:17:25
11:23:05
11:28:45
11:34:25
11:40:05
11:45:45
11:51:25
Input heating water temperature
Output heating water temperature
Air temperature - dry bulb temperature
Air temperature - wet bulb temperature

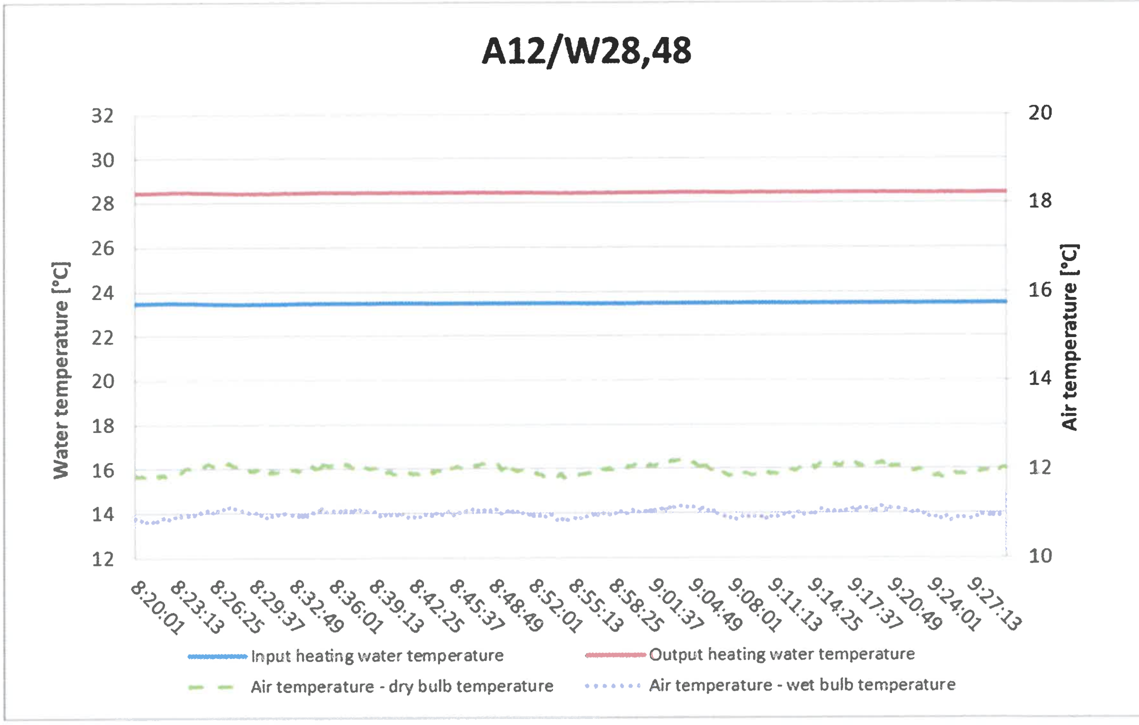

Effective electric power input, Corrected heating capacity, COP
Effective electric power input, Corrected heating capacity [kW]
COP [-]
14
12
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
5
4
3
2
1
0
9:52:25
9:58:21
10:04:17
10:10:13
10:16:09
10:22:05
10:28:01
10:33:57
10:39:53
10:45:49
10:51:45
10:57:41
11:03:37
11:09:33
11:15:29
11:21:25
11:27:21
11:33:17
11:39:13
11:45:09
11:51:05
Effective electric power input
Corrected heating capacity
COP

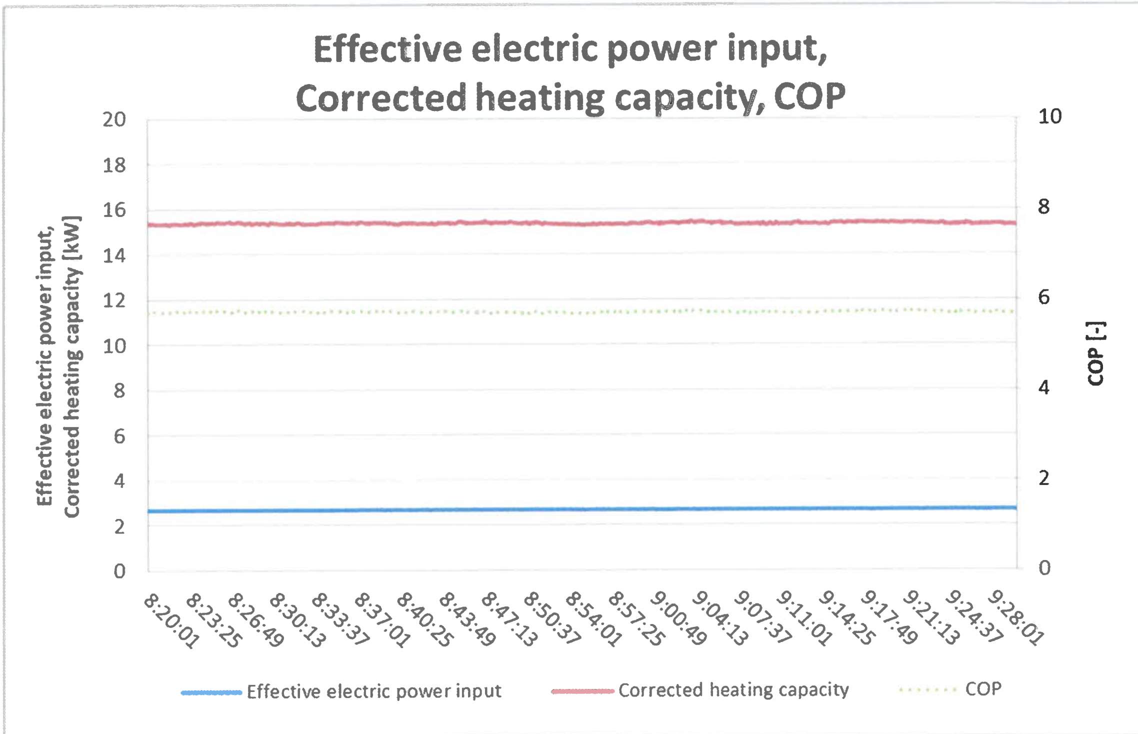
A7/W30.65


A7/W30,65
Water temperature [°C]
Air temperature [°C]
Input heating water temperature
Output heating water temperature
Air temperature - dry bulb temperature
Air temperature - wet bulb temperature

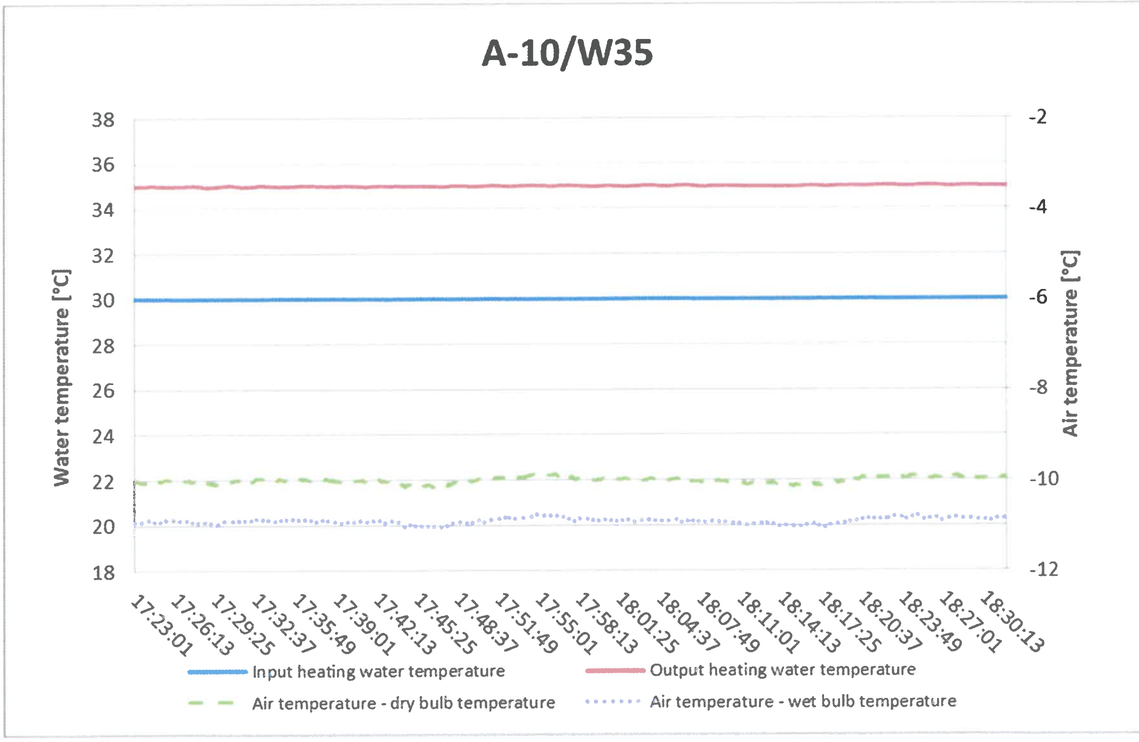

Effective electric power input,
Corrected heating capacity, COP
Effective electric power input,
Corrected heating capacity [kW]
COP [-]
Effective electric power input
Corrected heating capacity
COP

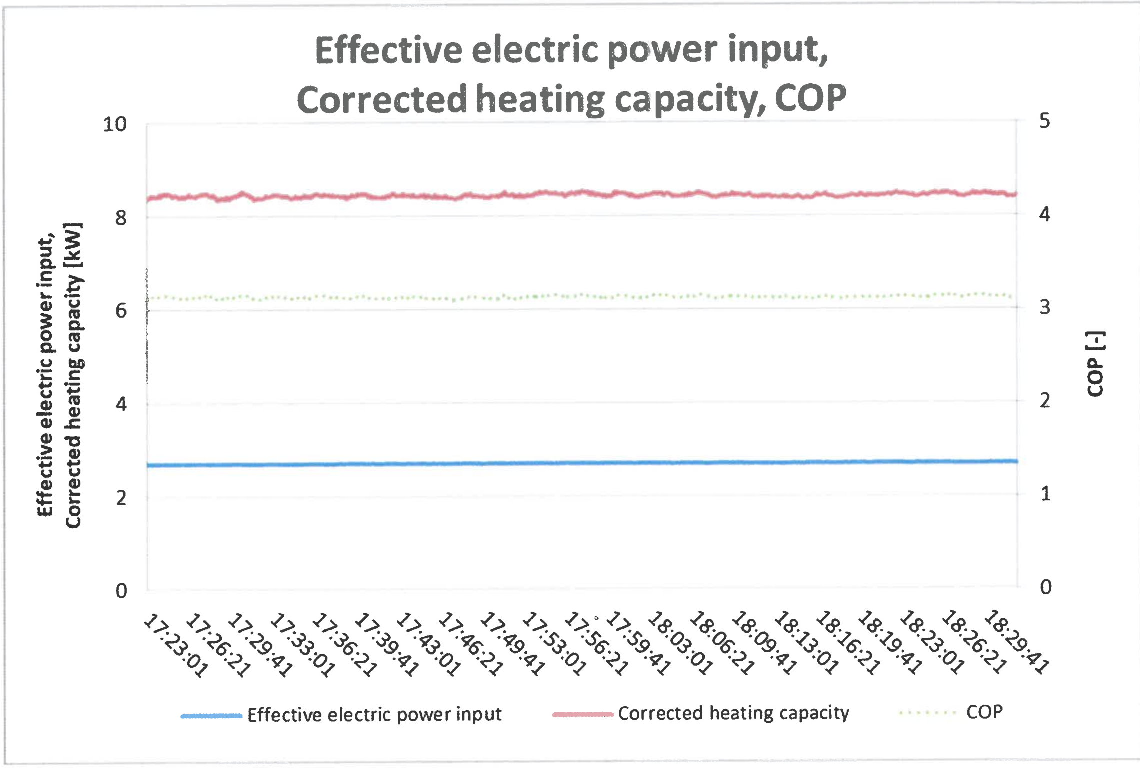
A12/W28.48


A12/W28,48
Water temperature [°C]
Air temperature [°C]
32
30
28
26
24
22
20
18
16
14
12
20
18
16
14
12
10
8:20:01
8:23:13
8:26:25
8:29:37
8:32:49
8:36:01
8:39:13
8:42:25
8:45:37
8:48:49
8:52:01
8:55:13
8:58:25
9:01:37
9:04:49
9:08:01
9:11:13
9:14:25
9:17:37
9:20:49
9:24:01
9:27:13
Input heating water temperature
Output heating water temperature
Air temperature - dry bulb temperature
Air temperature - wet bulb temperature


Effective electric power input,
Corrected heating capacity, COP
Effective electric power input,
Corrected heating capacity [kW]
COP [-]
20
18
16
14
12
10
8
6
4
2
0
10
8
6
4
2
0
8:20:01
8:23:25
8:26:49
8:30:13
8:33:37
8:37:01
8:40:25
8:43:49
8:47:13
8:50:37
8:54:01
8:57:25
9:00:49
9:04:13
9:07:37
9:11:01
9:14:25
9:17:49
9:21:13
9:24:37
9:28:01
Effective electric power input
Corrected heating capacity
COP

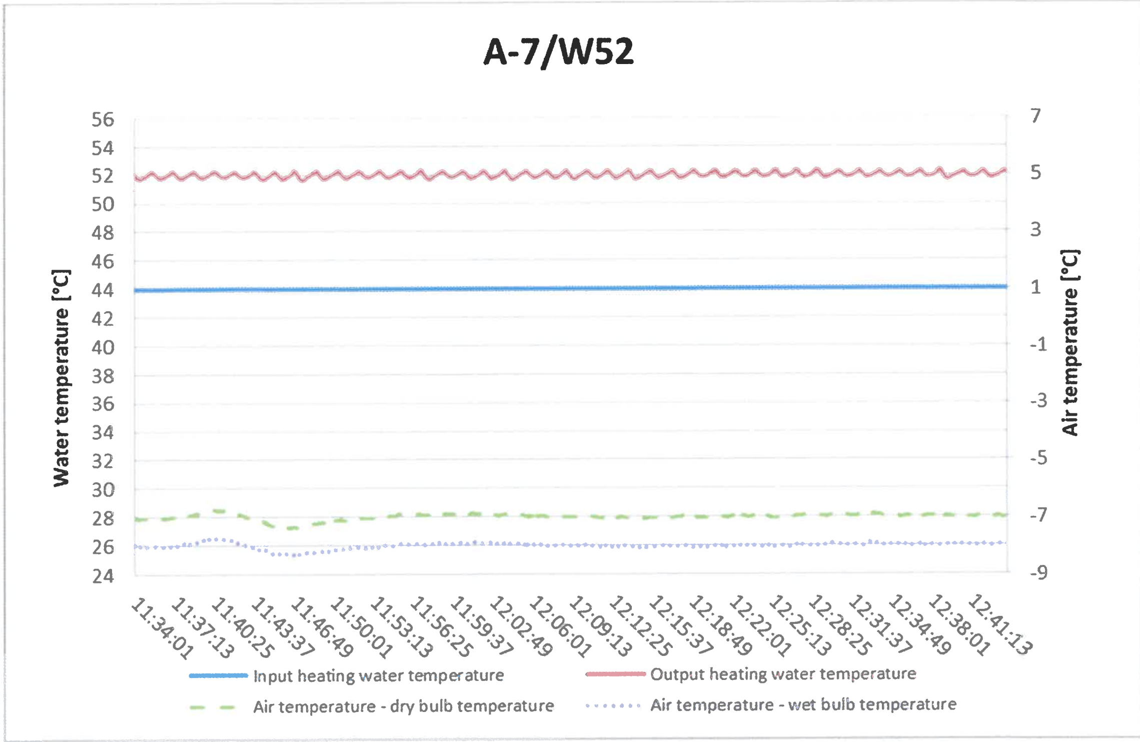
A-10/W35

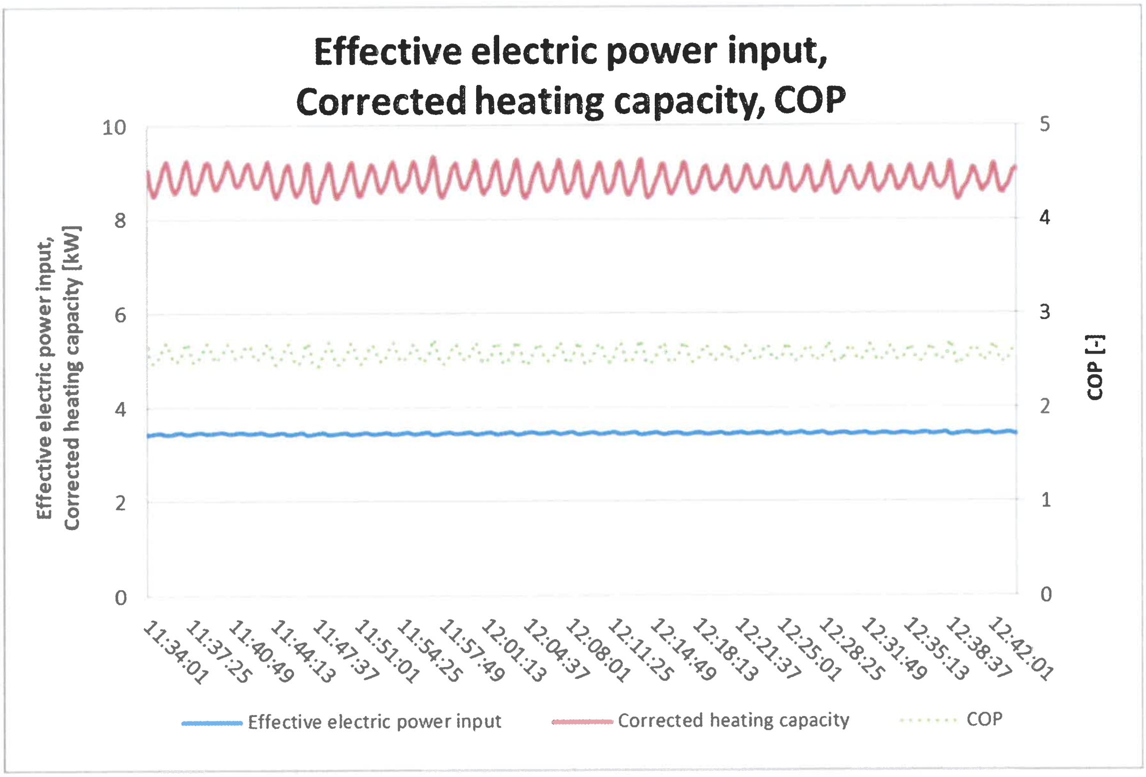

A-10/W35
Water temperature [°C]
Air temperature [°C]
38
36
34
32
30
28
26
24
22
20
18
-2
-4
-6
-8
-10
-12
17:23:01
17:26:13
17:29:25
17:32:37
17:35:49
17:39:01
17:42:13
17:45:25
17:48:37
17:51:49
17:55:01
17:58:13
18:01:25
18:04:37
18:07:49
18:11:01
18:14:13
18:17:25
18:20:37
18:23:49
18:27:01
18:30:13
Input heating water temperature
Output heating water temperature
Air temperature - dry bulb temperature
Air temperature - wet bulb temperature


Effective electric power input,
Corrected heating capacity, COP
Effective electric power input,
Corrected heating capacity [kW]
COP [-]
10
8
6
4
2
0
5
4
3
2
1
0
17:23:01
17:26:21
17:29:41
17:33:01
17:36:21
17:39:41
17:43:01
17:46:21
17:49:41
17:53:01
17:56:21
17:59:41
18:03:01
18:06:21
18:09:41
18:13:01
18:16:21
18:19:41
18:23:01
18:26:21
18:29:41
Effective electric power input
Corrected heating capacity
COP

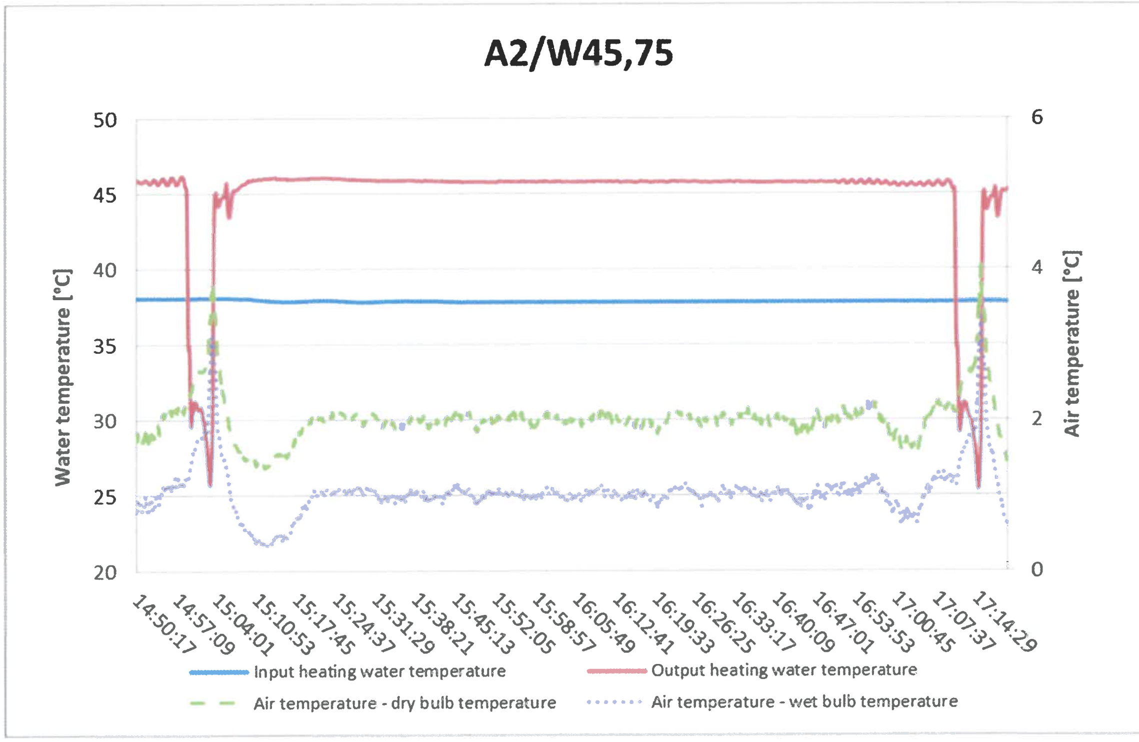
2. Seasonal performance tests and SCOP calculation – Medium temperature application

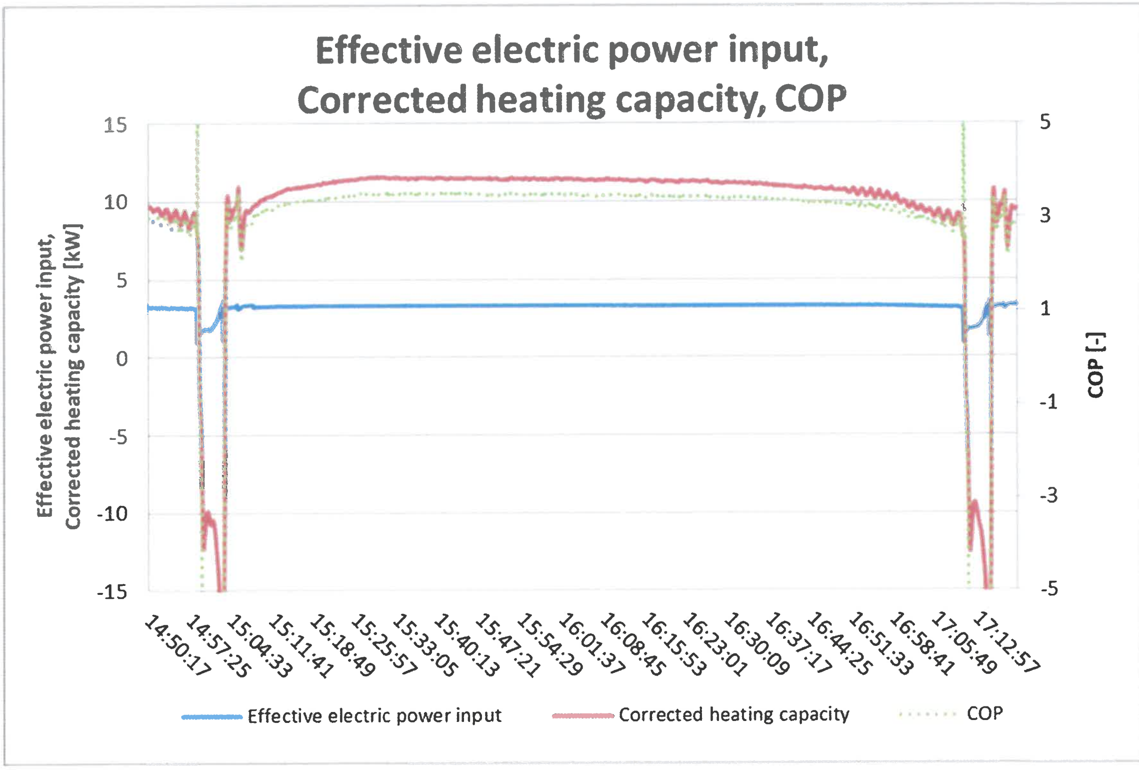
A-7/W52



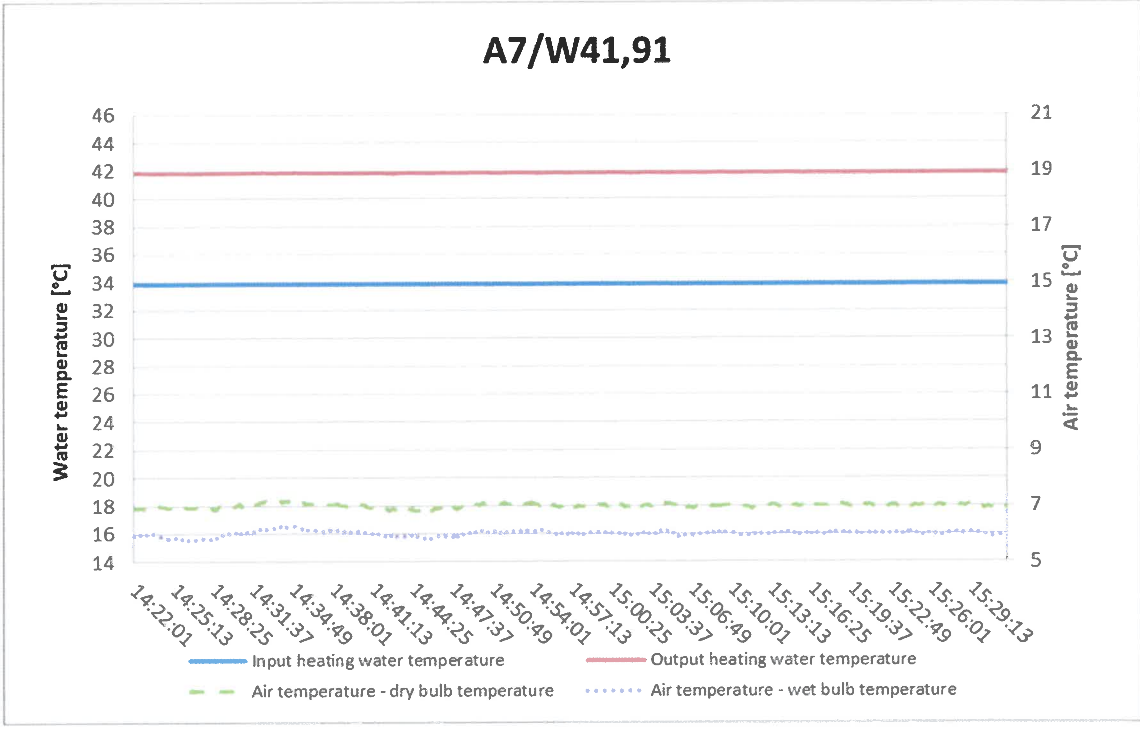


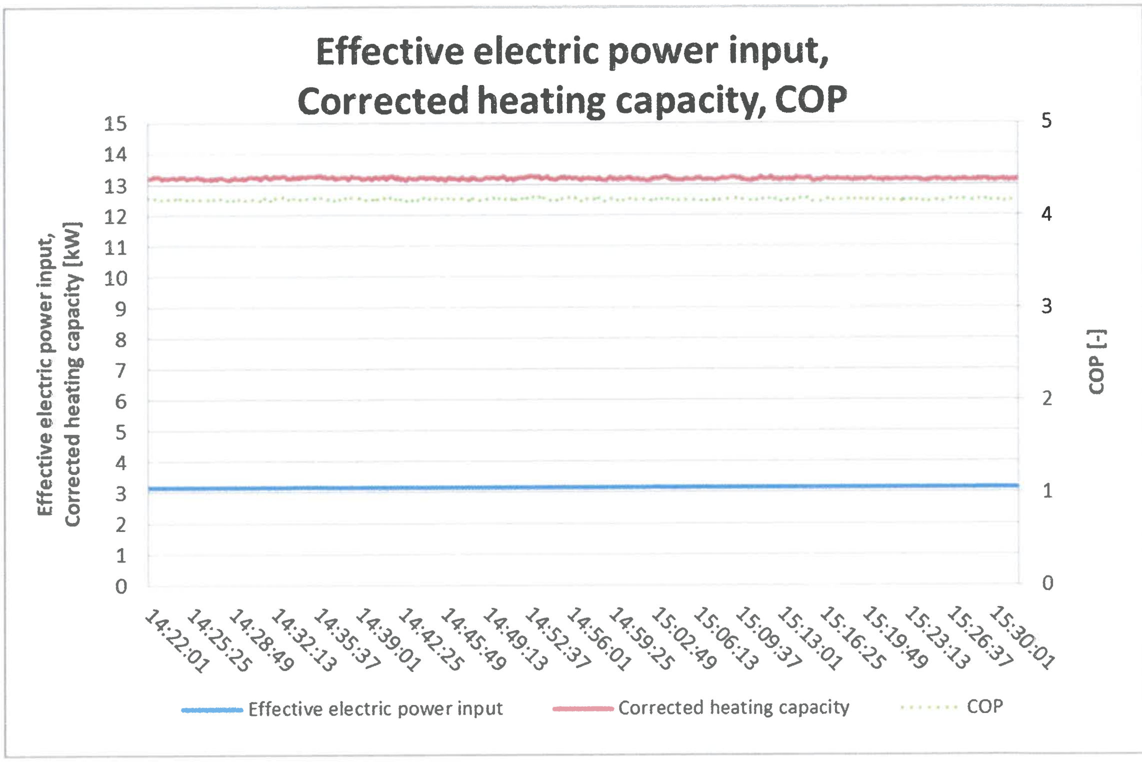
A2/W46.75


A2/W45,75
Water temperature [°C]
Air temperature [°C]
50
45
40
35
30
25
20
6
4
2
0
14:50:17
14:57:09
15:04:01
15:10:53
15:17:45
15:24:37
15:31:29
15:38:21
15:45:13
15:52:05
15:58:57
16:05:49
16:12:41
16:19:33
16:26:25
16:33:17
16:40:09
16:47:01
16:53:53
17:00:45
17:07:37
17:14:29
Input heating water temperature
Output heating water temperature
Air temperature - dry bulb temperature
Air temperature - wet bulb temperature

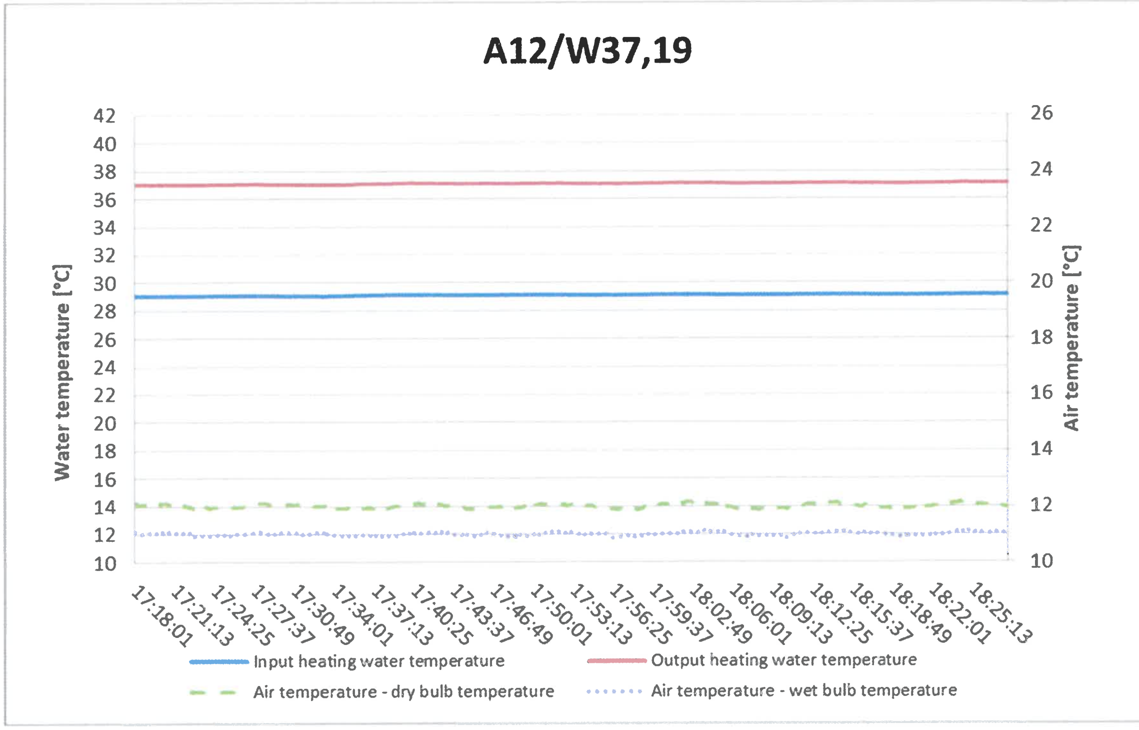

Effective electric power input,
Corrected heating capacity, COP
Effective electric power input,
Corrected heating capacity [kW]
COP [-]
15
10
5
0
-5
-10
-15
5
3
1
-1
-3
-5
14:50:17
14:57:25
15:04:33
15:11:41
15:18:49
15:25:57
15:33:05
15:40:13
15:47:21
15:54:29
16:01:37
16:08:45
16:15:53
16:23:01
16:30:09
16:37:17
16:44:25
16:51:33
16:58:41
17:05:49
17:12:57
Effective electric power input
Corrected heating capacity
COP

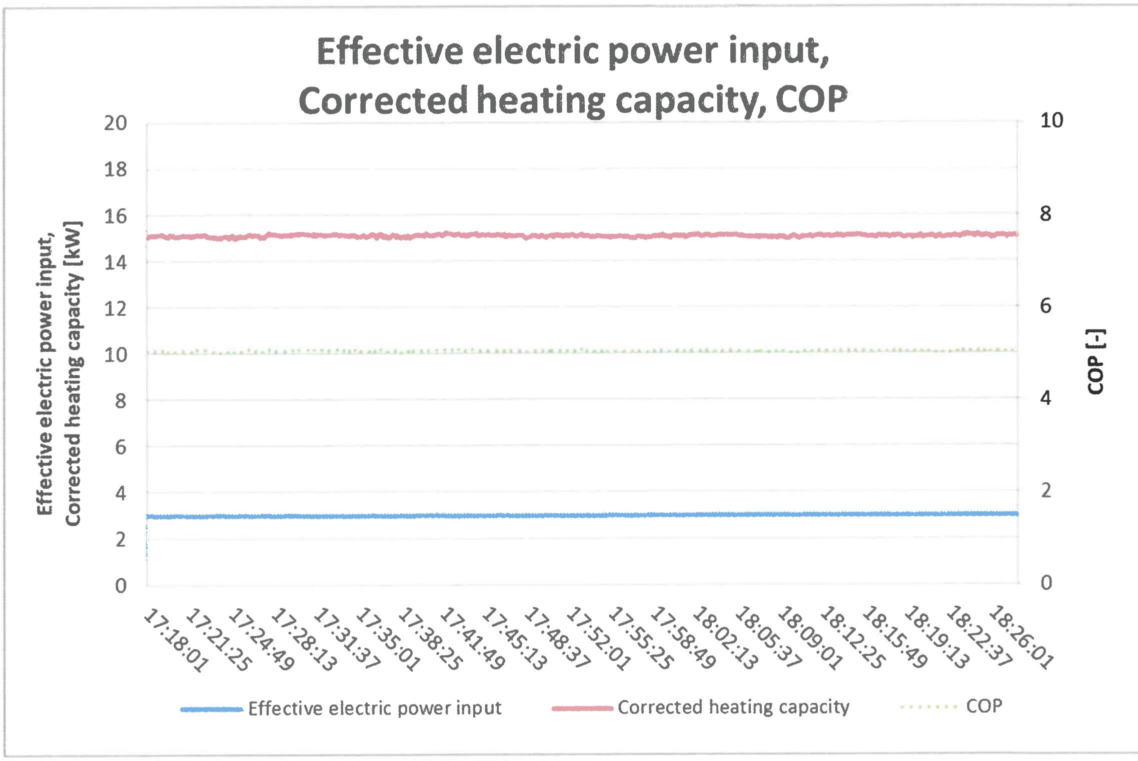
A7/W41.91


A7/W41,91
Water temperature [°C]
Air temperature [°C]
Input heating water temperature
Output heating water temperature
Air temperature - dry bulb temperature
Air temperature - wet bulb temperature

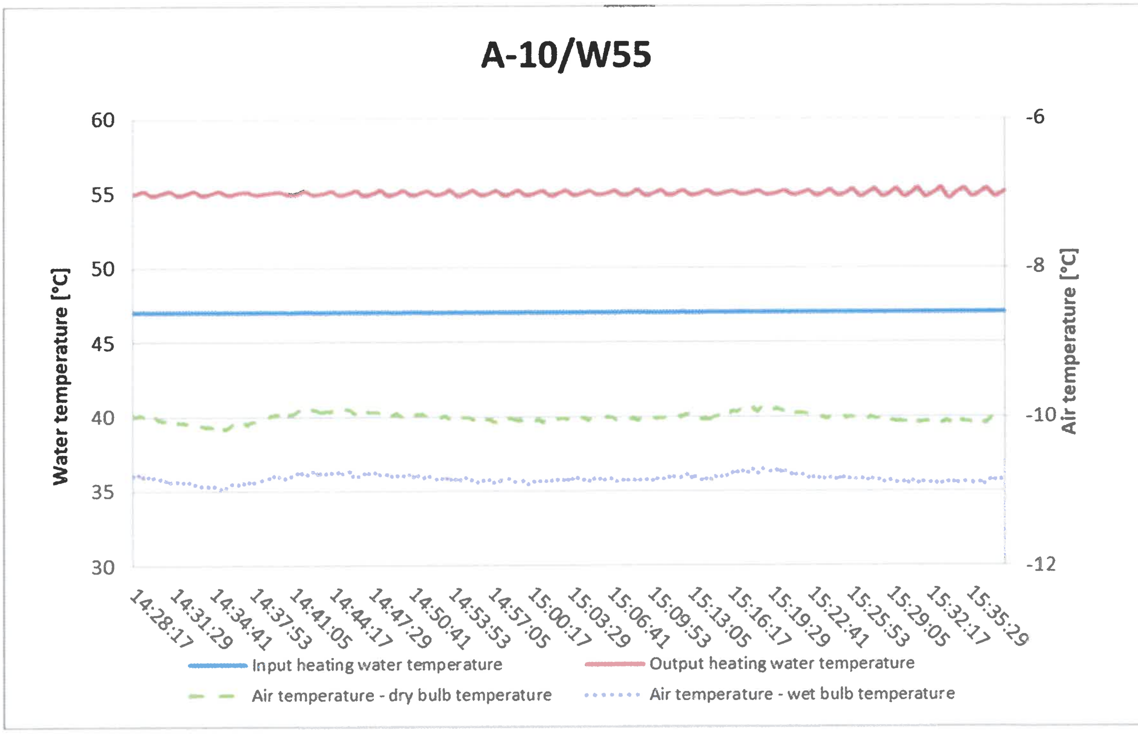

Effective electric power input,
Corrected heating capacity, COP
Effective electric power input,
Corrected heating capacity [kW]
COP [-]
Effective electric power input
Corrected heating capacity
COP

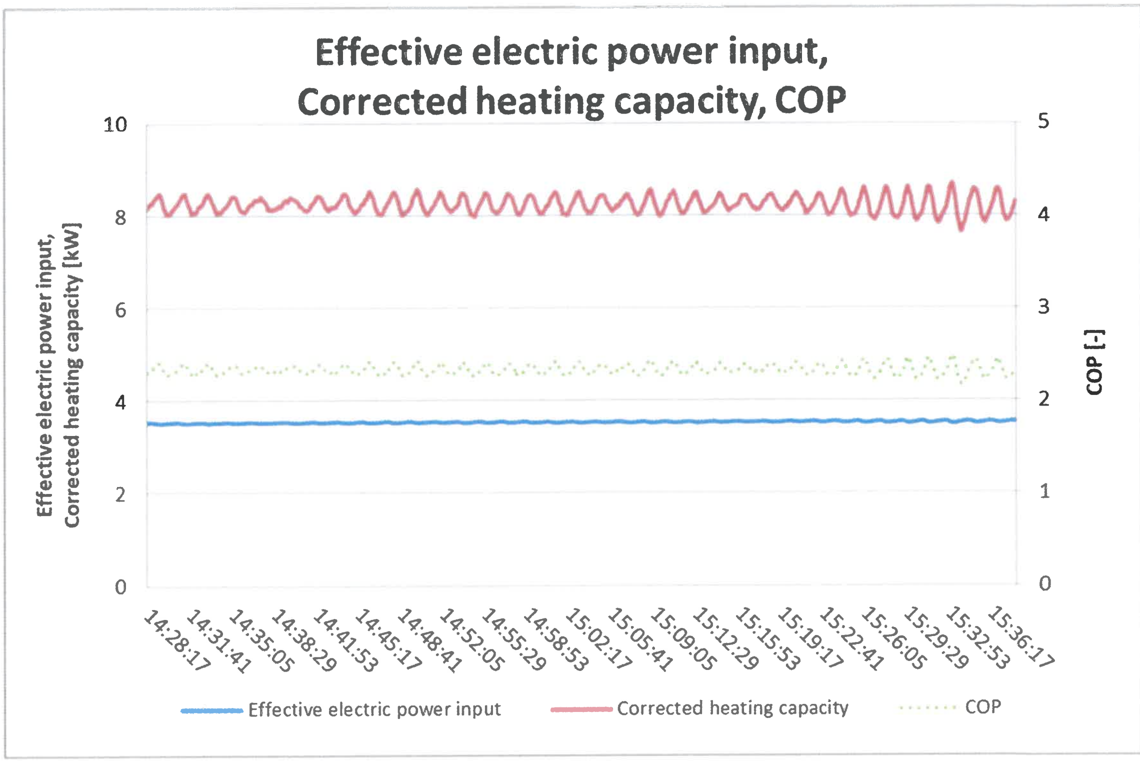
A12/W37.19


A12/W37,19
Water temperature [°C]
Air temperature [°C]
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
26
24
22
20
18
16
14
12
10
17:18:01
17:21:13
17:24:25
17:27:37
17:30:49
17:34:01
17:37:13
17:40:25
17:43:37
17:46:49
17:50:01
17:53:13
17:56:25
17:59:37
18:02:49
18:06:01
18:09:13
18:12:25
18:15:37
18:18:49
18:22:01
18:25:13
Input heating water temperature
Output heating water temperature
Air temperature - dry bulb temperature
Air temperature - wet bulb temperature


Effective electric power input,
Corrected heating capacity, COP
Effective electric power input,
Corrected heating capacity [kW]
COP [-]
20
18
16
14
12
10
8
6
4
2
0
10
8
6
4
2
0
17:18:01
17:21:25
17:24:49
17:28:13
17:31:37
17:35:01
17:38:25
17:41:49
17:45:13
17:48:37
17:52:01
17:55:25
17:58:49
18:02:13
18:05:37
18:09:01
18:12:25
18:15:49
18:19:13
18:22:37
18:26:01
Effective electric power input
Corrected heating capacity
COP

A-10/W55


A-10/W55
Water temperature [°C]
Air temperature [°C]
60
55
50
45
40
35
30
-6
-8
-10
-12
14:28:17
14:31:29
14:34:41
14:37:53
14:41:05
14:44:17
14:47:29
14:50:41
14:53:53
14:57:05
15:00:17
15:03:29
15:06:41
15:09:53
15:13:05
15:16:17
15:19:29
15:22:41
15:25:53
15:29:05
15:32:17
15:35:29
Input heating water temperature
Output heating water temperature
Air temperature - dry bulb temperature
Air temperature - wet bulb temperature


Effective electric power input,
Corrected heating capacity, COP
Effective electric power input,
Corrected heating capacity [kW]
COP [-]
10
8
6
4
2
0
5
4
3
2
1
0
14:28:17
14:31:41
14:35:05
14:38:29
14:41:53
14:45:17
14:48:41
14:52:05
14:55:29
14:58:53
15:02:17
15:05:41
15:09:05
15:12:29
15:15:53
15:19:17
15:22:41
15:26:05
15:29:29
15:32:53
15:36:17
Effective electric power input
Corrected heating capacity
COP

VI. A list of referenced documents

- Order of 2023-05-21 (Order reg. no. B-82288, received on 2023-05-21)
- Test report 39-17488/T of 2024-03-21
- ČSN EN 14511-2:2023 - Air conditioners, liquid chilling packages and heat pumps for space heating and cooling and process chillers, with electrically driven compressors - Part 2: Test conditions
- ČSN EN 14511-3:2023 - Air conditioners, liquid chilling packages and heat pumps for space heating and cooling and process chillers, with electrically driven compressors - Part 3: Test methods
- ČSN EN 14825:2023 - Air conditioners, liquid chilling packages and heat pumps, with electrically driven compressors, for space heating and cooling, commercial and process cooling - Testing and rating at part load conditions and calculation of seasonal performance

Test Report compiled by: Ing. Jakub Čederle

Accredited Testing Laboratory No. 1045.1 * STROJÍRENSKÝ ZKUŠEBNÍ ÚSTAV, s.p. * 1

Test Report approved by: Ing. Mario Jankola
Heating Equipment and Construction Products Manager

– End of Test Report –